DRAFT RISK ASSESSMENT METHODOLOGY

EAST TROY CONTAMINATED AQUIFER SITE TROY, MIAMI COUNTY, OHIO

Prepared for



U.S. Environmental Protection Agency Region 5 Chicago, Illinois

Prepared by



1 South Wacker Drive, 37th Floor Chicago, Illinois 60606

February 2014

DRAFT RISK ASSESSMENT METHODOLOGY EAST TROY CONTAMINATED AQUIFER SITE TROY, MIAMI COUNTY, OHIO

TABLE OF CONTENTS

Secti	<u>ion</u>				Page		
1.0	INTR	ODUCTIO	NC		1		
2.0	HUM	HUMAN HEALTH RISK ASSESSMENT					
	2.1	DATA	3				
	2.2	2.2 EXPOSURE ASSESSMENT					
		2.2.1	Exposur	re Setting Characterization	7		
		2.2.2	Exposur	re Pathway Identification	8		
		2.2.3	Exposur	re Quantification	11		
			2.2.3.1	Exposure Point Concentrations	11		
			2.2.3.2	Exposure Modeling	12		
			2.2.3.3	Intake Calculation Algorithms	13		
	2.3	TOXIC	CITY ASS	SESSMENT	14		
	2.4	2.4 RISK CHARACTERIZATION					
		2.4.1	Characte	erization of Cancer Risk	15		
		2.4.2	Hazard.		16		
		2.4.3	Soil Gas	S Screening	16		
		2.4.4	Lead		17		
	2.5	UNCE	RTAINT	Y ASSESSMENT	17		
3.0	SCRE	ENING L	EVEL E	COLOGICAL RISK ASSESSMENT	18		
REF	ERENCE	ES			22		
				FIGURES			
FIGURE 1		SITE L	SITE LOCATION MAP				
FIGURE 2		SITE LAYOUT					
FIGURE 3		HUMAN HEALTH CONCEPTUAL SITE MODEL					
FIGURE 4		ECOLO	ECOLOGICAL CONCEPTUAL SITE MODEL				

ATTACHMENT

ATTACHMENT A Federal and State Lists of Threatened, Endangered and Candidate Species

RISK ASSESSMENT METHODOLOGY EAST TROY CONTAMINATED AQUIFER SITE TROY, MIAMI COUNTY, OHIO

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) tasked SulTRAC to prepare a human health risk assessment (HHRA) and a screening level ecological risk assessment (SLERA) for the East Troy Contaminated Aquifer (ETCA) Site. Summaries of the basis, methodology, and contents of the draft HHRA and the SLERA reports are presented below.

2.0 HUMAN HEALTH RISK ASSESSMENT

The primary objective of the HHRA is to evaluate whether site contaminants pose a current or potential risk to human health in the absence of remediation. The HHRA will be used to determine whether remediation is necessary at the site, provide justification for remedial action, and identify what exposure pathways must be remediated.

The ETCA Site is located in Troy, Miami County, Ohio, and includes two general areas of groundwater contamination lying west of the Great Miami River (GMR) that are believed to originate from separate, multiple sources (see Figure 1). One area of contamination, referred to as the "Residential Area PCE Plume," originates in the vicinity of East Main and Walnut Streets (see Figure 2). It extends southeastward beneath a primarily residential area. The second area of contamination, referred to as the "Water Street Plume," extends from the vicinity of the Hobart Brothers Cabinet (Hobart) property on East Water Street and southeastward beneath a mixed industrial, residential, and institutional area. Adjacent to the Hobart facility is a second industrial facility, Spinnaker Coatings LLC (Spinnaker), also where chlorinated volatile organic compounds (VOC) contamination has been detected in soil and groundwater.

The site also includes groundwater contamination on the east side of the GMR. The municipal water supply wells (PW-) in the City of Troy's East Wellfield are monitored monthly for VOCs. Cis-1,2-dichloroethene (cDCE) has been detected in well PW-18. Before 2005, cis-1,2-DCE was occasionally detected in well PW-14, and cDCE has more recently been detected sporadically in wells PW-4E and PW-17. VOCs have also been detected in and around the City of Troy's West Wellfield, which lies approximately 1 mile upgradient (northwest) from the ETCA site. Current information indicates that the sources of contamination at the ETCA site are separate and different from those that affected the West Wellfield; thus, the West Wellfield is not considered part of the ETCA site.

SulTRAC will conduct HHRA activities at the ETCA Site consistent with EPA and state guidance. The guidance documents to be used in preparing the HHRA are listed below. This list is not comprehensive, and other EPA and state guidance documents, as well as documents prepared by other organizations, will be used as appropriate.

- 1. EPA. 1989. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)" (RAGS)*. Interim Final. Office of Emergency and Remedial Response (OERR). Washington, D.C. EPA/540/1-89/002. December.
- 2. EPA. 1991. "RAGS, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors." Interim Final. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03. March 25.
- 3. EPA. 1992. "Guidance for Data Usability in Risk Assessment (Part A) Final." OERR. Publication 9285.7-09A. April.
- 4. EPA. 2001. *RAGS, Volume 1 Human Health Evaluation Manual Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments*. Final. Office of Superfund Remediation and Technology Innovation. Publication 9285.7-47. December.
- 5. EPA. 2002a. "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)." OSWER. EPA530-D-02-004. November.
- 6. EPA. 2002b. "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites." OSWER 9285.6-10. December.
- 7. EPA. 2003. "Human Health Toxicity Values in Superfund Risk Assessments." OSWER Directive 9285.7-53. December.
- 8. EPA. 2004a. "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings." OERR. February 22.
- 9. EPA. 2004b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. OSWER. EPA/540/R/99/005. July.
- 10. EPA. 2005. "Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens." Risk Assessment Forum. EPA/630/R-03/003F. March.
- 11. EPA. 2009a. *RAGS, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*. Office of Superfund Remediation and Technology Innovation. EPA-540-R-070-002. January.
- 12. EPA. 2010a. "Vapor Intrusion Guidebook." Region 5, Superfund Division. October. On-Line Address: http://www.epaosc.org/sites/3806/files/VI%20Guidebook%20-%20%2010-1-10%20-%20final%20version.pdf
- 13. EPA. 2011. "Exposure Factors Handbook: 2011 Edition." Office of Research and Development (ORD). EPA/600/R-090/052F. September. On-Line Address: http://www.epa.gov/ncea/efh/pdfs/efh-complete.pdf
- 14. EPA. 2013a. OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level (VISL) Calculator, Version 3.1, June 2013 RSLs. June. On-Line Address: http://www.epa.gov/oswer/vaporintrusion/guidance.html

- 15. EPA. 2013b. Vapor Intrusion Screening Level (VISL) Calculator User's Guide. OSWER. June. On-Line Address: http: www.epa.gov/oswer/vaporintrusion/documents/VISL-UsersGuide.pdf
- 16. EPA. 2013d. "ProUCL Version 5.0.00 User Guide, Statistical Software for Environmental Applications for Data Sets With and Without Nondetect Observations." ORD Site Characterization and Monitoring Technical Support Center (SCDMTSC). EPA/600/R-07/041. September. On-Line Address: http://www.epa.gov/osp/hstl/tsc/ProUCL_v5.0_user.pdf
- 17. EPA. 2013e. "Regional Screening Level (RSL) Summary Table, November 2013." On-Line Address: http://www.epa.gov/region9/superfund/prg/
- 18. EPA. 2013f. "User's Guide for Regional Screening Levels (November 2013)." On-Line Address: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration table/usersguide.htm
- Ohio Environmental Protection Agency (OEPA). 2010c. Sample Collection and Evaluation of Vapor Intrusion to Indoor Air, For Remedial Response and Voluntary Action Programs. May. On-Line Address: http://www.epa.ohio.gov/portals/30/rules/vapor%20intrusion%20to%20indoor%20air.pdf
- 20. Virginia Department of Environmental Quality (VDEQ). 2013. Voluntary Remediation Program Risk Assessment Guidance. May. On-Line Address: http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance.aspx

As described in EPA's RAGS, the risk assessment will be conducted in four basic steps: (1) data evaluation and identification of chemicals of potential concern (COPC), (2) exposure assessment, (3) toxicity assessment, and (4) risk and hazard characterization. In addition, the HHRA will include a discussion and evaluation of significant sources of uncertainties in the risk assessment process as applied at the ETCA Site. Each of these risk assessment elements is summarized below.

2.1 DATA EVALUATION AND IDENTIFICATION OF COPCs

The HHRA will be based on available medium-specific analytical results associated with remedial investigation (RI) activities (Phase I [December 2009 through spring 2012], Phase II [August 2012 through July 2013], and Expanded Phase II [November 2013 through completion]) conducted at the ETCA Site. Numerous groundwater, soil, indoor air, soil gas, surface water and sediment samples have been or will be collected and analyzed in these investigations, as summarized below.

• Phase I

- Reviewed split sample results from five Spinnaker monitoring wells sampled by Kimberly Clark (KC) for Spinnaker; split samples collected in December 2009.
- O Collected baseline groundwater samples (n=19) from all existing Ohio EPA (n=13) and City of Troy (n=6) monitoring wells (August 2010).
- O Surface water and sediment samples from GMR. (Four locations; one upgradient and three adjacent to and downgradient from ETCA Site. [Note: one of the adjacent

- locations SW-003/SD-003 is at the upstream end of the adjacent segment of the river immediately upgradient of Hobart. The primary basis for this location is to differentiate between any contamination that may be arising from the west wellfield plume area and the ETCA site. Therefore, this location may also be considered to be an "upgradient" location.]) (September 2010.)
- O Collected screening-level groundwater samples from five borings to help define the eastern and southern borders of the Residential Area PCE Plume (December 2011).
- Collected sub-slab vapor and indoor air samples from 18 properties (16 residential and two businesses) (January 2012).
- O Collected groundwater samples (n=41) from all existing Ohio EPA wells (except OEPA-5) (n=12), City of Troy (n=6), newly installed Phase I monitoring wells (n=19), and several Spinnaker (n=2) and Miami Conservancy District (MCD) wells located adjacent to the GMR (n=2) (spring 2012).
- Collected 63 soil samples from 34 borings installed to investigate and characterize potential source areas and "hot spots"; also collected screening-level groundwater samples collected from 15 borings to define the eastern extent of the Residential Area PCE Plume (Spring 2012).

Phase II

- Second round (summer seasonal) of vapor intrusion (VI) locations sampled in Phase I (n=15) (August 2012). (Note: three locations sampled in Phase I did not allow access for second round of sampling).
- O Screening groundwater samples (n=13) from borings to the water table (December 2012).
- Vertical aquifer sampling (VAS) groundwater samples from three locations between the GMR and the East Well Field (January 2013).
- O Soil samples from potential source area borings (n=27) and residential yards between Hobart and Spinnaker operations (n=4), and screening groundwater samples from several of the source area borings at water table (n=13) (February 2013).
- O Groundwater samples from all Ohio EPA wells (n=13), City of Troy (n=6), Phase I and II (n=28), Spinnaker (n=3), and MCD (n=2) monitoring wells (March 2013).
- Sub-slab vapor and indoor air samples from residential (n=8) and commercial (n=2) locations (May 2013).
- Expanded Phase II (details are from sampling plan; sampling has been only partially completed; thus, the actual location and number of samples may change, the information presented here represents the work completed to date). (Note: membrane interface probe (MIP) soil borings were completed at several properties and were used to identify areas for further groundwater sampling; therefore, details on numbers and locations of MIP locations are not provided below. However, related groundwater and soil samples collected to date based on MIP results are summarized).
 - o 10 E. Main Street (former dry cleaner).
 - Six groundwater VAS borings using high resolution site characterization (HRSC) techniques.
 - o 432 E. Main Street (former dry cleaner/current electronics shop).

- Two groundwater VAS borings using HRSC techniques.
- o Hobart Cabinet (potential source of Water Street Plume).
 - Soil borings and samples from (1) beneath the paved loading dock the "garage-like" structure (2 borings = 6 samples), (2) the open area near loading dock (6 borings = 23 [plus 5 duplicates] samples), and (3) the open area between the building and levee (5 surface samples and 3 borings with 9 samples, 14 total).
 - Two groundwater screening samples from paved basement/garage area beneath the loading dock.
 - Four groundwater VAS borings using HRSC techniques.

Spinnaker

- Six groundwater VAS borings using HRSC techniques.
- Five soil borings and samples from (1) the western side of the western parking lot area in the vicinity of monitoring well KMW-10 (19 samples and 1 duplicate), (2) 5 borings at various other locations in the western parking lot (18 samples), (3) 2 borings at the area near the northwest corner of the building (6 samples), and (4) 3 borings in the area between the building and the levee (9 samples and 4 duplicates).

Site-wide

- Fourteen groundwater VAS borings along and across the Residential Area PCE Plume using HRSC techniques.
- Seven groundwater VAS borings along and across the Water Street Plume
- A monitoring well installed at the leading edge of the Residential Area PCE Plume.
- Surface water samples from GMR if results from the VAS transect along the levee, southeast of the Spinnaker building, exceed surface water quality standards.

The cumulative analytical results will be evaluated in accordance with EPA's *Guidance for Data Usability in Risk Assessment (Part A) Final* (EPA 1992) to determine whether the data may be used in a quantitative risk assessment. The evaluation process will be documented as part of HHRA activities.

Medium-specific COPCs will be selected following the process described in EPA's RAGS. The first step is to identify all chemicals positively detected in at least one sample, including (1) chemicals with no data qualifiers, and (2) chemicals with data qualifiers indicating known identities but estimated concentrations (for example, J-qualified data). As discussed in RAGS, this initial list of chemicals may be reduced based on the following factors:

• Evaluation of detection frequency (chemicals detected in less than 5 percent of samples and not potentially site-related will not be retained as COPCs). (Note: before eliminating any chemical based on detection frequency, the presence of any areas of elevated concentrations [such as site-related hot spots] will be evaluated).

- Evaluation of essential nutrients.
- Use of a concentration-toxicity screen (the more conservative [lower]) of chemical-, receptor-, and medium-specific levels for each medium:
 - Soil: EPA Regional Screening Levels (RSL) for residential soil (EPA 2013e) (Note: the RSLs are based on a target risk of 1E-06 and a target hazard quotient [HQ] of 1;a target HQ of 0.1 will be used for selecting COPCs) and Ohio's Generic Direct Contact Standards for a Single Chemical (for residential land use Table I) (Ohio Administrative Code [OAC] 2009). (Note: Ohio EPA's generic numerical standard [GNS] values are based on a target risk of 1E-05 and a target risk of 1. Chemical-specific GNS values will be divided by a factor of 10 for identifying COPCs to be protective of human health and consistent with an adjustment for multiple chemicals as required by Ohio EPA [OAC 3745-300-08[D]]).
 - o **Sediment:** Sediment screening values for the protection of human health are generally not available. Therefore, sediment screening values will be selected as described above for soil. (Note: Several of the exposure assumptions used in the development of soil-based criteria are not likely relevant to this exposure media because exposure to sediment is likely to be less intense and less frequent than exposure to soil. Thus, this screening value for sediment is conservative.)
 - Surface Water: Total and dissolved surface water data will be screened against the minimum of Ohio Water Quality Standards (OWQS) based on public and recreational use (as appropriate) (Ohio EPA 2010a); and National Water Quality Standards (NWQS) (EPA 2009) if available. If surface water-specific values are not identified from these sources for a given constituent, surface water results will be screened against tapwater RSLs (EPA 2013e) (based on a target risk of 1E-06 and a target HQ of 0.1 [as described above for soil]).
 - O Groundwater: EPA tapwater RSLs (EPA 2013e), EPA Vapor Intrusion Screening Levels (VISL) Calculator (EPA 2013a) (based on a target risk of 1E-06 and a target HQ of 0.1 [as described above for soil]) (EPA 2013e), maximum contaminant levels (MCL) (EPA 2012)], and Ohio's Generic Unrestricted Potable Use Standards (Table V) (OAC 2009). (Note: Ohio EPA GNS values will be divided by a factor of 10 as described above for soil.)

After these factors have been considered, those chemicals with maximum detected concentrations exceeding screening levels or for which screening levels are not available will be retained as medium-specific COPCs. One-half of the maximum detection limit (DL) of a constituent not detected in a given medium will be compared with the appropriate screening level to ensure that elevated DLs do not result in inappropriate exclusion of chemicals from further evaluation. The results of these comparisons may result in inclusion of a nondetected chemical as a COPC or discussion of the potential impact of excluding such a chemical as part of the uncertainty discussion.

As described in EPA's RAGS, background screening was a secondary step in the COPC selection process (EPA 1989). However, based on more recent EPA guidance, background screening will not be

considered in the selection of COPCs for the ETCA site (EPA 2002c). (Note: medium-specific soil and groundwater chemical concentrations [and associated risks and hazards] measured on-site and downgradient of the site will be compared with chemical concentrations [and associated risks and hazards] from background locations as part of the uncertainty assessment.) The primary contamination associated with the ETCA site is volatile organic compounds (VOC), including tetrachloroethene (PCE), trichloroethene (TCE), and cDCE. VOCs have been measured in groundwater from two plumes within the sand and gravel aquifer: Residential Area PCE Plume and Water Street Plume, and across (east) of the GMR in City of Troy East Wellfield water supply wells. VOCs have also been measured in sub-slab vapor and indoor air from homes and commercial businesses located above the Residential Area PCE Plume.

2.2 EXPOSURE ASSESSMENT

The exposure assessment presents the methods used to estimate the types and magnitudes of potential human exposure to COPCs in various media. EPA's RAGS defines exposure as human contact with a chemical or physical agent. The exposure assessment consists of three fundamental steps: (1) exposure setting characterization (including characterizing the site and potential receptors), (2) exposure pathway identification through a conceptual site model (CSM), and (3) exposure quantification. Each of these steps is briefly discussed below.

2.2.1 Exposure Setting Characterization

The exposure setting consists of the physical setting (including natural and man-made features), land uses, and the populations living near the site. This information forms the foundation for selecting potential receptors, exposure pathways, and exposure parameters (for example, how often a receptor may visit the site). As noted in Section 2.0, the ETCA Site consists primarily of two general areas of groundwater contamination lying west of the GMR: the Residential Area PCE Plume (beneath a primarily residential area), and the Water Street Plume (beneath a mixed industrial, residential, and institutional area).

Consistent with the RI and for the HHRA, the ETCA Site will be divided into four general exposure areas (see Figure 2):

- Residential Area PCE Plume
- Water Street Plume
- City of Troy East Wellfield
- GMR

The first two exposure areas, Residential Area PCE and Water Street Plumes, are expected to be subdivided into smaller exposure areas based on land use, location relative to specific source areas, and medium-specific VOC concentrations. For example, the Water Street Plume is likely to be divided into at least three sub-exposure areas: Hobart, Spinnaker, and residential property located between Hobart and Spinnaker along Water Street. Final decisions on the number and location of any sub-exposure areas will be based on review of all available analytical data from Phases I, II, and expanded Phase II investigations and will be discussed with EPA and Ohio EPA regulators.

Finally, as noted in Section 2.1, exposures and associated risks and hazards will be characterized at background locations as identified below:

- Residential Area PCE Plume well EPA-108S
- Water Street Plume wells EPA-122S and OEPA-13
- Great Miami River SW004 (surface water) and SD004 (sediment). Note: one of the adjacent locations SW-003/SD-003 is at the upstream end of the adjacent segment of the river immediately upgradient of Hobart. The primary basis for this location is to differentiate between any contamination that may be arising from the west wellfield plume area and the ETCA Site. Therefore, this location may also be considered to be an "upgradient" location.

There are no site-specific soil background locations. Site-related soil concentrations will be compared with available regional background concentrations including the "average concentrations of elements in Miami County, Ohio" from the U.S. Geological Survey's (USGS) Mineral Resources On-Line Spatial Data (USGS 2012).

2.2.2 Exposure Pathway Identification

Exposure pathways to be considered in the HHRA will be identified through a human health CSM. The CSM links potential or actual contaminant releases to potential human exposures. Specifically, the CSM identifies (1) potential contaminant sources and mechanisms of release, (2) potential receptors and exposure pathways, and (3) exposure scenarios. Figure 3 presents the human health CSM for the ETCA site.

Consistent with EPA's RAGS, the ETCA Site HHRA will consider only complete (or potentially complete) exposure pathways. As described in RAGS, an exposure pathway generally consists of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium (or media in cases involving media transfer of chemicals), (3) a point of potential human contact with the contaminated medium, and (4) an exposure route (for example, ingestion). As shown in Figure 3, seven

different types of potentially exposed human receptors will be considered in the HHRA. Each of these receptors is summarized below:

- Current and Future Commercial/Industrial Workers (adults only): Current commercial/industrial workers include workers currently working at various neighborhood commercial operations overlying the Residential Area PCE Plume and at the Hobart and Spinnaker industrial operations overlying the Water Street Plume (see Figure 2).
- Current and Future Construction Workers (adults only): Potential exposure by construction workers will be evaluated under both current and potential future land use conditions in areas overlying both the Residential Area PCE Plume and the Water Street Plume (see Figure 2).
- **Current and Future Utility Workers** (adults only): Potential exposure by utility workers will be evaluated under both current and potential future land use conditions in areas overlying both the Residential Area PCE Plume and the Water Street Plume (see Figure 2).
- Recreationalists (all ages): As described in Section 2.2.1, the ETCA Site is located in a mixed residential and commercial/industrial area. However, both the Residential Area PCE Plume and the Water Street Plume may discharge into the GMR. The GMR near the site is largely channelized, but is being used for recreational purposes such as fishing. Based on the limited amount of available data, potential exposures via direct exposure to chemicals in surface water and sediment in and along the river, as well as through ingestion of aquatic life (such as fish) from the GMR are expected to be insignificant. Potential recreational exposures (and related risks and hazards) will be addressed quantitatively only if screening levels are exceeded (see Section 2.1); otherwise, recreational exposures, risks, and hazards will be evaluated only qualitatively in the HHRA.
- **Current Residents** (children and adults): Residents currently live in the ETCA Site, particularly in the neighborhood overlying the Residential Area PCE Plume, as well as in a small number of residential properties located near Hobart property overlying the Water Street Plume.
- Future Residents (children and adults): Areas of the site currently being used for residential purposes residences are likely to continue residential into the future. However, additional areas currently being used for commercial or industrial purposes (for example, north of the Spinnaker Building or within the parking lot between the Hobart and Spinnaker operations) may be converted to residential land use in the future. Finally, potential future residential exposure via potable use of groundwater from untreated MCD supply wells will be evaluated qualitatively in the uncertainty discussion.

The primary exposure scenarios at the site are expected to involve exposures to chemicals in groundwater and soil. As noted above for the recreationalist, potential exposures in the GMR (related to sediment and surface water) are expected to be insignificant and may not be retained for quantitative analysis. Receptor-specific exposure scenarios to be considered in the HHRA are identified in Figure 3 and summarized below:

• Current and Future Commercial/Industrial Worker

- o Inhalation of fugitive and volatile emissions to ambient air from surface and subsurface (future only) soil.
- Incidental ingestion of and dermal contact with surface and subsurface (future only) soil.
- o Ingestion of groundwater (future only).
- o Inhalation of indoor air contaminated by volatile COPCs via the VI exposure pathway.

Current and Future Construction Workers

- o Incidental ingestion of, dermal contact with, and inhalation of fugitive and volatile emissions from subsurface soil (Note: subsurface soil will be defined as soil from 0 to 10 feet below ground surface [bgs] and includes surface soil [0 to 6 inches bgs].)
- Dermal contact with and inhalation of volatile COPCs from groundwater within a
 construction trench. (Note: groundwater is assumed to enter and accumulate in
 construction trenches only if only if the groundwater table is above 8 feet bgs; if the
 depth to groundwater is below 8 feet bgs, then no dermal contact with groundwater will
 be assumed.)

• Current and Future Utility Workers

- o Incidental ingestion of, dermal contact with, and inhalation of fugitive and volatile emissions from subsurface soil (Note: subsurface soil will be defined as soil from 0 to 10 feet below ground surface [bgs] and includes surface soil [0 to 6 inches bgs].)
- Dermal contact with and inhalation of volatile COPCs from groundwater within a
 construction trench. (Note: groundwater is assumed to enter and accumulate in
 construction trenches only if only if the groundwater table is ≤ 8 feet bgs; if the depth to
 groundwater is > 8 feet bgs, then no dermal contact with groundwater will be assumed.)

• Current and Future Recreationalists

- o Incidental ingestion of and dermal contact with surface water and sediment.
- o Ingestion of aquatic life (such as fish).

• Current Residents

- o Inhalation of indoor air contaminated by volatile COPCs via the VI exposure pathway.
- Incidental ingestion of, dermal contact with, and inhalation of fugitive dusts and volatile emissions from surface soil (only in homes near the Hobart operation along Water Street).
- Potential ingestion of and dermal contact with groundwater from private wells; current exposures based on private well use will be evaluated only if supported by the results of the planned residential survey.

• Future Residents

- o Inhalation of fugitive and volatile emissions to ambient air from surface and subsurface (future only) soil.
- o Incidental ingestion of and dermal contact with surface and subsurface (future only) soil.
- o Ingestion of, dermal contact with, and inhalation of volatile COPCs from groundwater associated with potable groundwater use.

- o Inhalation of indoor air contaminated by volatile COPCs via the VI exposure pathway.
- Potential ingestion of and dermal contact with groundwater from private wells; future exposures based on private well use will be assumed under future land use conditions even if no current use of private wells is identified from the planned residential survey.

2.2.3 Exposure Quantification

Receptor-specific exposures will be quantified using standard exposure dose equations that consider a variety of parameters, including medium-specific COPC concentrations (referred to as the exposure point concentration [EPC]), contact rate, the frequency and duration of exposure, and receptor-specific body weight. Consistent with EPA guidance, exposures will be quantified under both reasonable maximum exposure (RME) conditions (the maximum exposure reasonably assumed to occur) and central tendency exposure (CTE) conditions (the typical or average exposure).

Exposure parameters are based on standard default values or recommendations (not available for all receptors) as modified based on site-specific conditions. RAGS D Table 4s, which lists draft receptor-specific exposure factors, will be submitted under separate cover.

2.2.3.1 Exposure Point Concentrations

Medium-specific EPCs (with the exception of groundwater – see below) for most receptors will be selected as the lesser of the 95 percent upper confidence limit (UCL) of the mean and the maximum detected concentration at each exposure point. EPCs for the RME and CTE scenarios will be calculated as the 95 percent upper confidence limit (UCL) on the mean for each exposure area using EPA's ProUCL Version 5.0.00 statistical software package (EPA 2013d). The EPC was generally selected as the 95 percent UCL of the statistical method recommended by ProUCL. However, following EPA (2002b, 2013d), this value may be estimated by either a 95, 97.5, or 99 percent UCL, depending on the sample size, skewness, and degree of censorship. Statistical treatment will not be conducted for constituents with fewer than eight detected results in a data set. In this circumstance, the maximum detected concentration will be used as the EPC. EPCs for construction workers will also be based on maximum detected concentrations at each exposure area.

Groundwater presents unique circumstances that complicate the calculation of EPCs. Receptors are not expected to be exposed to groundwater from multiple locations across an exposure area. Rather, receptors may ingest groundwater from a single well installed at a particular location or may have direct

contact with groundwater in a construction trench at a particular location. As a result, EPCs for groundwater will be calculated in several ways.

Under current land use conditions no receptors (residential and industrial/commercial workers) are using untreated site groundwater as a source of potable water. However, construction and utility workers may be exposed via inhalation of VOCs released from groundwater and entering the air inside a trench. Under future land use conditions, receptors will be assumed to use site groundwater as a potable water supply. Between two and five groundwater wells (including monitoring wells and VAS wells) within each exposure and sub-exposure area will be identified for the HHRA; wells located outside of the plumes (identified by limited or no contamination and VOC concentrations less than screening levels) will not be considered in calculating groundwater EPCs. Based on these groundwater wells, EPCs will be calculated using EPA's ProUCL software as described above. It should be noted that if a VAS well is selected as one of the wells assigned to an exposure area, only the shallowest VAS interval results will be considered for calculating a groundwater EPC for use in groundwater to trench or indoor air modeling (see Section 2.3.1.2). This approach reflects the fact that any VOCs in deeper groundwater are unavailable for VI, as they would first need to pass through shallower groundwater.

Potential exposures via the VI exposure pathway will be based preferentially on the results of available property-specific indoor air samples. Indoor air concentrations will be modeled from shallow groundwater concentrations in areas where indoor air samples are absent (see Section 2.2.3.2). (Note: sub-slab vapor samples were collected only at locations where indoor air samples were also collected.) In addition, the risk assessment will also note and discuss all location-specific areas where EPA's VISL target sub-slab and exterior soil gas concentrations and target groundwater concentrations have been exceeded (EPA 2013a and 2013b). These elevated results will be discussed because measuring indoor air concentrations and modeling indoor air concentrations from groundwater results are both associated with uncertainty. Thus, even if risks and hazards based on indoor air concentrations modeled from soil gas or groundwater concentrations are characterized as insignificant, the elevated results identified above will note the potential for unacceptable indoor air concentrations. Risk managers can weigh these lines of evidence in determining the need for remedial action.

2.2.3.2 Exposure Modeling

In addition to quantifying exposures based on direct medium measurements, the ETCA Site HHRA may also conduct modeling to fill data gaps, as summarized below.

• Subsurface vapor transport modeling may be used as necessary to fill gaps where samples of indoor air at particular current and potential future building locations have not been collected.

Any modeling will be conducted consistent with EPA and Ohio EPA guidance including EPA's "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)" (EPA 2002a), "User's Guide for Evaluating Subsurface Vapor Intrusion into Building" (EPA 2004a), EPA's VISL Calculator (EPA 2013a, 2013b), and Ohio EPA's "Sample Collection and Evaluation of Vapor Intrusion to Indoor Air, for Remedial Response and Voluntary Action Programs" (Ohio EPA 2010c).

- A nonchemical-specific mass transport volatilization factor (VF) of 0.5 liter per cubic meter (L/m³) will be used to estimate concentrations of volatile chemicals in indoor air as a result of household use of groundwater (EPA 2013f).
- Migration of VOCs into the air inside construction trenches will be evaluated using a methodology developed by the Virginia Department of Environmental Quality (VDEQ) as part of its "Voluntary Remediation Program Risk Assessment Guidance" (VDEQ 2013).
- If deemed necessary, modeling of soil concentrations into homegrown produce may also occur.

While VOCs in groundwater are expected to volatilize and migrate from groundwater into ambient air, contributions from this exposure pathway are expected to be insignificant as compared with inhalation exposures related to vapor intrusion and household use. Therefore, potential migration of VOCs from groundwater to ambient air and related exposure pathways will not be evaluated as part of the HHRA.

2.2.3.3 Intake Calculation Algorithms

EPA-derived algorithms will be used to calculate chronic daily intakes for each exposure route. The generic equations for calculating chemical intake are provided below (EPA 1989, 2009a):

$$I (oral or dermal) = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

I (inhalation) =
$$\frac{C \times ET \times EF \times ED}{AT}$$

Where:

- I = Intake: the amount of chemical at the exchange boundary from oral or dermal exposure (milligrams per kilogram [mg/kg]-day for oral and dermal exposure; milligrams per cubic meter [mg/m³] for inhalation exposure)
- C = Chemical concentration within the exposure medium: the EPC (for example, mg/kg for soil)
- CR = Contact rate: the amount of contaminated medium contacted orally or dermally per unit of time or event; may be the ingestion rate or dermal contact rate (for example, milligrams per day [mg/day] for the ingestion rate of soil). The contact rate is not applicable to inhalation exposures.
- ET = Exposure time: number of hours of exposure (hours per day [hr/day]); exposure time is applicable only to inhalation exposures.

- EF = Exposure frequency: how often the exposure occurs (days per year)
- ED = Exposure duration: the number of years a receptor comes in contact with the contaminated medium (years)
- BW = Body weight: the average body weight of the receptor over the exposure period (kilograms); applicable only to oral and dermal exposures
- AT = Averaging time: the period over which exposure is averaged (days for oral and dermal exposures; hours for inhalation exposures).

For carcinogens, the averaging time is 25,550 days (oral and dermal exposures) and 613,200 hours (inhalation exposures) on the basis of a lifetime exposure of 70 years, which represents the average life expectancy.

For noncarcinogens, the averaging time is the exposure duration expressed in days (ED x 365 days/year) for oral and dermal exposures and in hours (ED x 365 days/year x 24 hr/day) for inhalation exposures.

Pathway-specific variations of the generic equations above were used to calculate intakes of COPCs. The proposed receptor-specific exposure parameters used in variations of these equations will be presented in RAGS D Table 4s (to be submitted under separate cover).

Furthermore, EPA guidance regarding evaluation of risk from early-life exposure to carcinogens recommends a different approach to estimating chemical intake for carcinogenic chemicals with a mutagenic mode of action (EPA 2005). This guidance will be incorporated and used to modify the above equations consistent with EPA's RSL User's Guide (EPA 2013f).

2.3 TOXICITY ASSESSMENT

The toxicity assessment identifies the toxicity factors that will be used to quantify potential adverse effects (including both carcinogenic and noncarcinogenic effects) on human health associated with potential exposure to site-specific COPCs. COPC-specific toxicity factors will be identified from EPA's RSL tables (EPA 2013e), which list toxicity values selected in accordance with EPA's revised recommended toxicity value hierarchy (EPA 2003), summarized below.

- Tier 1 EPA's Integrated Risk Information System (IRIS) (EPA 2014)
- Tier 2 EPA's provisional peer-reviewed toxicity values (PPRTV)
- Tier 3 Other EPA and non-EPA sources of toxicity information, including, but not limited to, (1) the California Environmental protection Agency (Cal/EPA) toxicity values, (2) the Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRL), and EPA's Health Effects Assessment Summary Tables (HEAST).

Chronic noncarcinogenic toxicity factors will be used for all receptors, with one exception. Subchronic toxicity factors will be used for construction workers because construction workers typically are expected to be exposed at a single site for a period of time less than 7 years (often 1 year or less).

2.4 RISK CHARACTERIZATION

Risk characterization combines the exposure estimates calculated in the exposure assessment with the toxicity factors identified in the toxicity assessment to calculate COPC-, exposure pathway-, and receptor-specific carcinogenic risks (risks) and noncarcinogenic hazards (hazards). Risks and hazards will be calculated following standardized methods described in EPA's RAGS (EPA 1989) and summarized below.

2.4.1 Characterization of Cancer Risk

Risks associated with exposure to chemicals classified as carcinogens are estimated as the incremental probability that an individual will develop cancer over a lifetime as a direct result of an exposure (EPA 1989). The estimated risk is expressed as a unitless probability.

Three steps are used in estimating cancer risks for chemicals classified as carcinogens. First, the chemical intake is multiplied by the chemical-specific slope factor (SF) (oral and dermal exposure) or the chemical-specific inhalation unit risk (IUR) (inhalation exposure) to derive a cancer risk estimate for a single chemical and pathway. The calculation is based on the following relationship:

- Chemical-Specific Cancer Risk (oral or dermal) = Intake (mg/kg-day) x SF (mg/kg-day)⁻¹
- Chemical-Specific Cancer Risk (inhalation) = Intake $(mg/m^3) \times 10^3 (\mu g/mg) \times IUR (\mu g/m^3)^{-1}$

Notes:

 $mg/m^3 = Milligram per cubic meter$

 $\mu g = Microgram$ mg = Milligram

Second, the individual chemical cancer risks are assumed additive to estimate the cancer risk associated with exposure to multiple carcinogens for a single exposure pathway, as follows:

• Pathway-Specific Cancer Risk = \sum Chemical-Specific Cancer Risk

Third, pathway-specific risks are summed to estimate the total cancer risk for each receptor.

2.4.2 Hazard

The potential for exposure that may result in adverse health effects other than cancer is evaluated by comparing the intake with a reference dose (RfD) (oral and dermal exposure) and with a reference concentration (RfC) (inhalation exposure) of each chemical not classified as a carcinogen, and of each carcinogen known to cause adverse health effects other than cancer. When calculated for a single chemical, the comparison yields a ratio termed the hazard quotient (HQ):

$$HQ (oral or dermal) = \underline{Intake (mg/kg-day)}$$

RfD (mg/kg-day)

HQ (inhalation) =
$$\frac{\text{Intake } (\text{mg/m}^3)}{\text{RfC } (\text{mg/m}^3)}$$

The HQs for all chemicals are summed to evaluate the potential for adverse health effects other than cancer from concurrent exposures to multiple chemicals, yielding a hazard index (HI) as follows:

$$HI = \sum HQ$$

Pathway-specific HIs are then summed to estimate a total HI for each receptor. An HI less than 1 indicates that adverse noncancer health effects are not expected. If the total HI exceeds 1, further evaluation in the form of a segregation of the HI via a target organ analysis may be performed to assess whether the noncancer HIs are a concern (EPA 1989). Target organ HIs greater than 1 may indicate a potential adverse effect. However, a target organ analysis will not be conducted in cases where the total HI exceeds 1 and the HQ for an individual COPC also exceeds 1 because the HQ results for the individual COPC already indicate that concern may be warranted.

2.4.3 Soil Gas Screening

The risk assessment will also note and discuss all location-specific and soil gas EPCs that exceed EPA's VISL target sub-slab and exterior soil gas concentrations and target groundwater concentrations because modeling indoor air concentrations from soil gas results is associated with significant uncertainty (EPA 2013a and 2013b). Thus, even if risks and hazards based on indoor air concentrations modeled from soil gas or groundwater concentrations are characterized as insignificant, the elevated results identified above will note the potential for unacceptable indoor air concentrations. Risk managers can weigh these lines of evidence in determining the need for remedial action.

2.4.4 Lead

Consistent with the sources of screening values to be used in the HHRA (see Section 2.1), potential risks from exposure to lead in soil by child and adult residents and adult commercial/industrial workers will be characterized by comparing the average concentration of lead in soil at each exposure area to the EPA RSLs (EPA 2013e). Specifically, risks to residential receptors will be characterized by comparing the average lead concentration in soil with the residential soil RSL of 400 mg/kg, which was calculated using the IEUBK model and default assumptions (EPA 2009b). Similarly, potential risks from exposure to lead in soil by adult commercial/industrial workers will be characterized by comparing the average lead concentration in soil with the industrial soil RSL of 800 mg/kg, which was calculated using the ALM (EPA 2009c, 2009d).

Potential risks from exposure to lead in soil by utility workers and construction workers are often characterized by comparing the average concentration of lead in soil at each exposure area with receptor-specific screening levels calculated using the most recent version of EPA's ALM (2009c), dated June 21, 2009. The ALM is designed to ensure protection of a fetus from exposure to unacceptable blood lead levels in its mother. However, based on samples collected to date, lead was found to exceed 400 mg/kg at only a single location (HOB-7), at a concentration of 927 mg/kg. Therefore, the average lead concentration is expected to be less than 400 mg/kg throughout the ETCA Site. Potential risks from exposure to lead in sediment by recreationalists will be characterized by comparing the average concentration of lead in sediment from the GMR with the residential soil RSL of 400 mg/kg. Similarly, potential risks from exposure to lead in soil by construction and utility workers will be initially characterized by comparing the maximum concentration of lead in subsurface soil with the industrial soil RSL of 800 mg/kg. As necessary, receptor-specific lead screening levels may be developed for construction and utility workers.

2.5 UNCERTAINTY ASSESSMENT

The risks and hazards calculated as part of the ETCA Site HHRA are subject to various degrees of uncertainty from a variety of sources associated with all the major phases of the HHRA process. The uncertainty assessment will identify and discuss the nature of the uncertainty (including direction [overestimation or underestimation] and magnitude) associated with the most significant sources of site-specific uncertainty (including particular assumptions and data limitations).

In addition, as discussed in Section 2.1, medium-specific soil and groundwater chemical concentrations (and associated risks and hazards) measured on-site and downgradient of the site will be compared with

chemical concentrations (and associated risks and hazards) from background locations. These comparisons will be designed to inform risk managers regarding context for interpreting site-related exposures, risks, and hazards.

3.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The primary objective of the SLERA is to address the contaminant identification, exposure assessment, toxicity assessment, and ecological risk characterization for the site.

SulTRAC will prepare the SLERA consistent with EPA and Ohio EPA guidance. The major guidance documents to be used in preparing the ERA will include the following:

- 1. EPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (ERAGS). Interim Final. OSWER. EPA-540-R-97-006. OSWER 9285.7-25.
- 2. EPA. 1993. Wildlife Exposure Factors Handbook. ORD. EPA/600/R-93/187. Washington, D.C.
- 3. EPA. 1998. "Guidelines for Ecological Risk Assessment." OSWER. EPA/630/R095-002F. April.
- 4. EPA. 1999. "Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities." Peer Review Draft. OSWER. EPA530-D-99-001. Washington, D.C.
- 5. EPA. 2013d. "ProUCL Version 5.0.00 User Guide, Statistical Software for Environmental Applications for Data Sets With and Without Nondetect Observations." ORD Site Characterization and Monitoring Technical Support Center (SCDMTSC). EPA/600/R-07/041. September. On-Line Address: http://www.epa.gov/osp/hstl/tsc/ProUCL_v5.0_user.pdf
- Ohio Environmental Protection Agency (Ohio EPA). 2008. "Guidance for Conducting Ecological Risk Assessment." Department of Emergency and Remedial Response. DERR-00-RR-031. April
- 7. Ohio EPA. 2010b. "Guidance on Evaluating Sediment Contaminant Results." Division of Surface Water, Standards and Technical Support Section. January.

SulTRAC will follow the basic protocols outlined in EPA's ERAGS and Ohio EPA guidance to evaluate potential risks to ecological communities (Ohio EPA 2008). These steps for ecological risk assessments are defined by three overall phases: problem formulation, analysis, and risk characterization. EPA defines these phases in an eight-step process. The first two steps constitute a SLERA, and the final six steps constitute a baseline ecological risk assessment (BERA). Presently, SulTRAC assumes that only a SLERA will be required for the site. Based on the results of the SLERA, SulTRAC will recommend and discuss with EPA the need for preparation of a BERA.

The ETCA site is within the city limits of Troy, Miami County, Ohio. Land use throughout the site is predominantly light/heavy industrial and residential. One apartment complex is in the north-central portion of the site, north of Ashland, Inc. The only potential terrestrial ecological habitat is near the GMR, along the west edge of the site. Beyond the site boundary, the other major habitat is the aquatic habitat associated with the GMR.

Environmental and natural resource agency information sources were searched for any available literature pertaining to previous ecological studies regarding the site and adjacent areas. This search included a review of state and federally threatened or endangered species listings for Miami County. The following subsections describe the ecological habitats observed at the ETCA Site.

According to the National Wetland Inventory (NWI) database, no wetlands are present on the site. The river itself is classified as a riverine wetland. The NWI does not identify wetland within the footprint of the groundwater contamination plume where groundwater is likely to discharge. Pockets of freshwater emergent and freshwater pond wetlands are located west of the GMR, adjacent to the municipal golf course (U.S. Fish and Wildlife Service [USFWS] 2014), but are outside the footprint of the plume. Dominant fish species upstream and through this area include golden redhorse, spotfin shiner, bluntnose minnow. smallmouth bass, black redhorse, and sand shiner (Ohio EPA 2013).

The site is in the Eastern Corn Belt Plains (ECBP) ecoregion of Ohio. The ECBP is mostly farmland and the major crops produced are corn and soybeans – 75 percent of the land is crop land, with the remaining land used as permanent pasture, small wooded areas, and urban/suburban development. The natural vegetation of the area consists of diverse hardwood forests – predominately beech and maple, with a significant amount of white, northern red, and black oak, tulip poplar, hickory, white ash, and black walnut (Whitaker and others 2012)

Ohio EPA (2013) conducted a biological assessment of the GMR that included the section of the river that passes adjacent to the site. Ohio EPA identified this section of the GMR as a warm water habitat (WWH). The current biological indices that included macroinvertebrates and fish communities have shown that the habitat near the site as good to high quality. Several the indices met the "exceptional" classification. The sampling locations that this classification are based on were either upstream or immediately downstream of the site. A portion of the GMR at the site is impounded by a lowhead dam, and Ohio EPA did not sample in the impounded portion of the river. The habitat along the GMR adjacent to the ETCA site is highly disturbed by industrial development, and the banks of the site side of the river have been highly engineered with concrete walls and dikes.

As part of the habitat characterizations, lists of endangered or threatened species known to occur in Miami County were obtained from the USFWS (2014) and ODNR (2014). Based on this review, it was determined that at the countywide level of information, the list of state and federally listed threatened, endangered, or rare species that potentially occur in Miami County is moderate: 16 plants and seven animals (Attachment A). Several of the state and federally listed plant and animal species potentially occur at or near the site based on their known distribution or habitat preferences.

SulTRAC will conduct an ecological risk assessment of the contamination associated with this habitat and any additional habitats identified during the habitat investigation. Based on the information available, the only habitat expected to be potentially affected from the known site releases is the GMR aquatic receptors. There are no known points where contaminated groundwater discharges to the surface within known ecological habitat areas and the source areas are industrial/commercial land use areas. As a result, exposures to receptors in the terrestrial habitat will not be evaluated. The following paragraphs provide an overview the steps to be taken to complete the SLERA for the site.

The first step in the SLERA process will be to conduct a screening level problem formulation and ecological effects evaluation by gaining thorough understanding of the ecological setting at the site, the chemicals or classes of chemicals present, their fate and transport properties, the mechanism of ecotoxicity of contaminants for probable categories of receptors, potentially complete exposure pathways, and preliminary endpoints. As part of this step, a preliminary ecological CSM has been developed (see Figure 4). The second step will be to estimate exposures using maximum concentrations of each contaminant of potential ecological concern (COPEC). The maximum COPEC concentrations will be identified for each habitat area. Data from the groundwater wells closest to the river will be the primary bases of evaluation because groundwater discharge to the GMR is the anticipated major pathway. Upstream data, if available, will also be evaluated.

These exposures will then be compared with acceptable exposure concentrations or toxicity reference values (TRV) to assess potential for unacceptable risk. Chronic Ohio Water Quality Standards (OWQS) will be selected as screening levels for surface water because the predominant focus is expected to be exposures to the aquatic community. If constituent-specific OWQS values are not available, constituent-specific results will be selected from EPA's Water Quality Criteria (EPA 2013c). If no values are available from EPA, SulTRAC will use values from state or other federal agencies, or from peer-reviewed literature. The screening values will be based on the no observed adverse effect level (NOAEL). An HQ, the ratio of the exposure concentration to the screening value, will be calculated for each COPEC in each habitat. An HQ for a COPEC greater than unity indicates a potentially unacceptable ecological risk for

that habitat. If requested by EPA, a food chain model could be used to assess potential impacts on higher trophic level organisms that could be using the river as a significant food source.

A SLERA report will evaluate each habitat and its completed exposure pathways, and whether site contamination poses a potentially unacceptable ecological risk. The SLERA report will also include a recommendation as to whether a BERA is appropriate for the site.

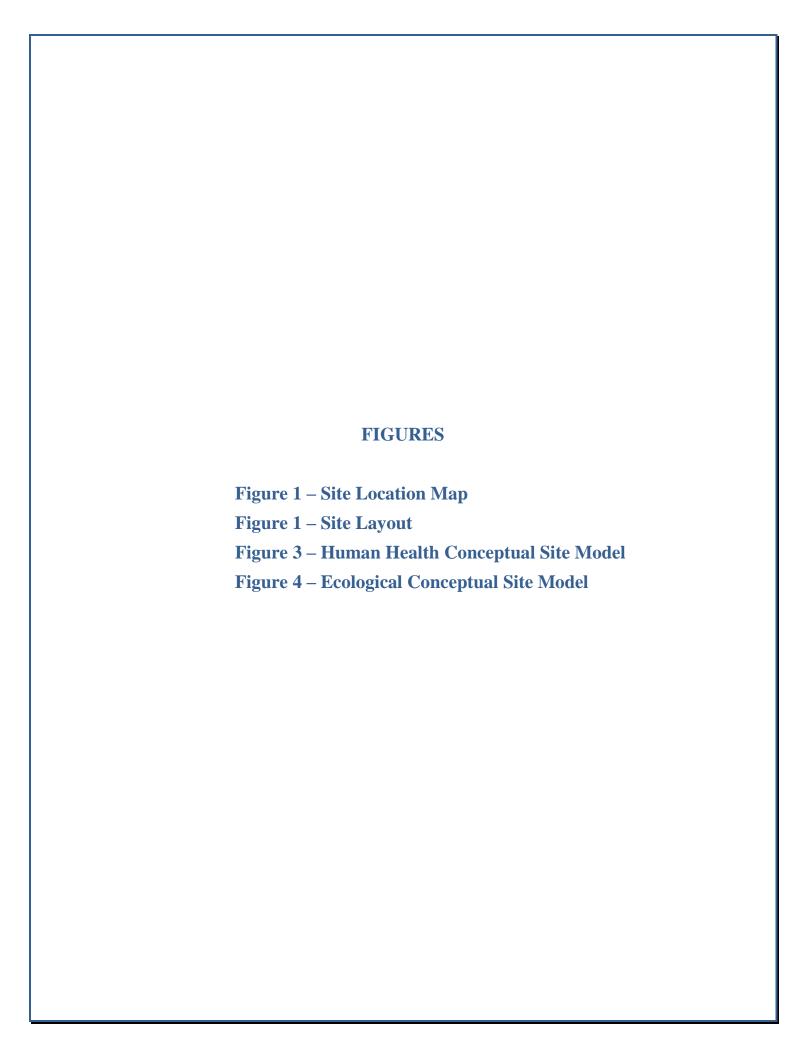
REFERENCES

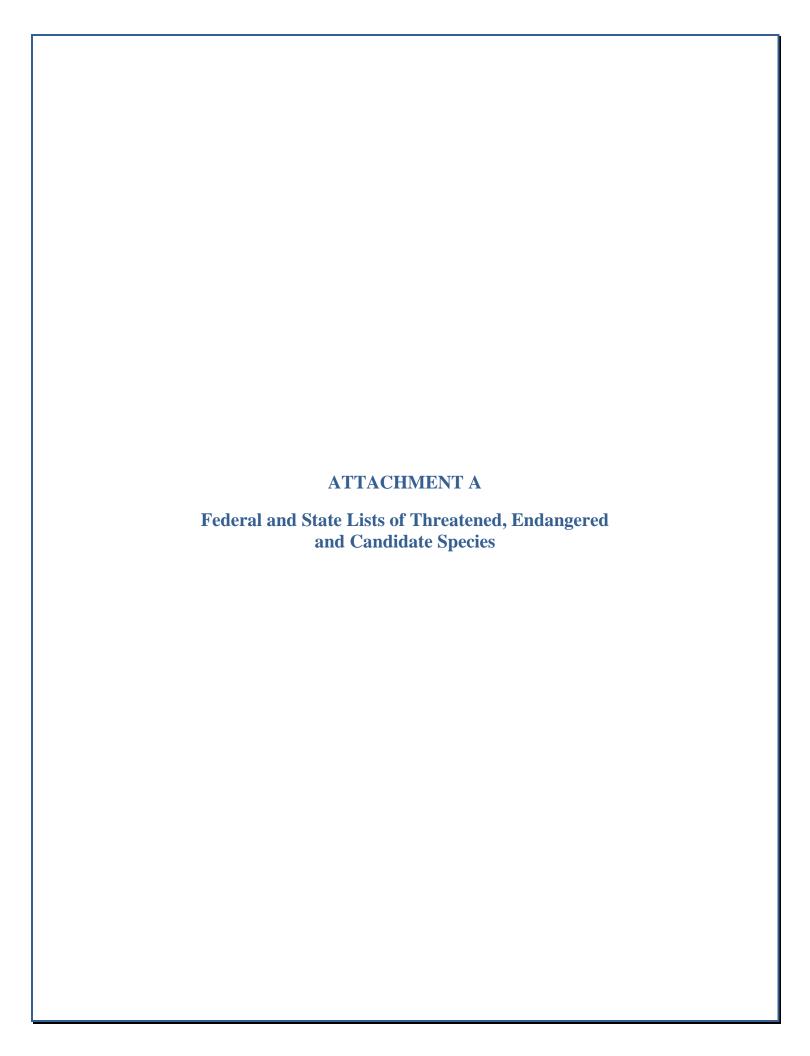
- Ohio Department of Natural Resources (Ohio DNR). 2014. Ohio State-listed Species by County, from Data in the Ohio Natural Heritage Database. Accessed January 2. On-line Address: http://www.dnr.state.oh.us/portals/9/resources/Biodiversity%20Database/Counties/miami.pdf
- Ohio Environmental Protection Agency (Ohio EPA). 2008. Guidance for Conducting Ecological Risk Assessment. Department of Emergency and Remedial Response. DERR-00-RR-031. April
- Ohio EPA. 2009. Ohio River Basin Aquatic Life and Human Health Tier 1 Criteria and Tier 2 Values. October 20. On-Line Address: http://www.epa.state.us/portals/35/wqs/Ohioval13.pdf
- Ohio EPA. 2010a. Water Quality Standards. Ohio Administrative Code (OAC) 3745-1. On-Line Address: http://www.epa.ohio.gov/dsw/rules/3745_1.aspx
- Ohio EPA. 2010b. Guidance on Evaluating Sediment Contaminant Results. Division of Surface Water, Standards and Technical Support Section. January.
- Ohio EPA. 2010c. Sample Collection and Evaluation of Vapor Intrusion to Indoor Air, for Remedial Response and Voluntary Action Programs. May. On-Line Address: http://www.epa.ohio.gov/portals/30/rules/vapor%20intrusion%20to%20indoor%20air.pdf
- Ohio EPA. 2013. Biological and Water Quality Study of the Middle Great Miami River and Principal Tributaries, 2009 Miami, Shelby, Montgomery, and Clark Counties. Division of Surface Water, Ecological Assessment Section. January 29. On-Line Address: http://www.epa.ohio.gov/Portals/35/documents/MGMR_TSD_2010.pdf
- U. S. Environmental Protection Agency (EPA). 1989. *Risk Assessment Guidance for Superfund, Volume*1: Human Health Evaluation Manual (Part A) (RAGS). Interim Final. Office of Emergency and Remedial Response (OERR). Washington, D.C. EPA/540/1-89/002. December.
- EPA. 1991. "RAGS, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors." Interim Final. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03. March 25.
- EPA. 1992. "Guidance for Data Usability in Risk Assessment (Part A) Final." OERR. Publication 9285.7-09A. April.
- EPA. 1993. *Wildlife Exposure Factors Handbook*. Office of Research and Development (ORD). EPA/600/R-93/187. Washington, D.C. December.
- EPA. 1997. "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments" (ERAGS). Interim Final. OSWER. EPA-540-R-97-006. OSWER 9285.7-25. June.
- EPA. 1998. "Guidelines for Ecological Risk Assessment." OSWER. EPA/630/R095-002F. April.
- EPA. 1999. "Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities." Peer Review Draft. OSWER. EPA530-D-99-001. Washington, D.C.

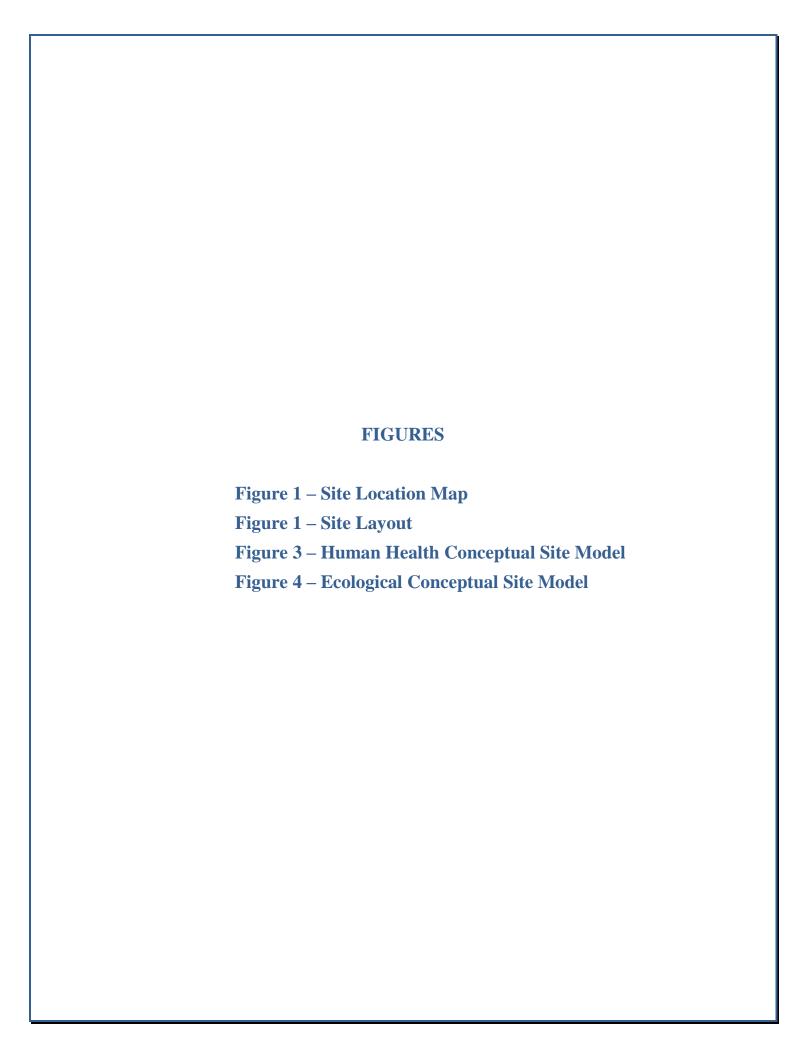
- EPA. 2001. *RAGS, Volume 1 Human Health Evaluation Manual Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments*. Final. Office of Superfund Remediation and Technology Innovation. Publication 9285.7-47. December.
- EPA. 2002a. "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)." OSWER. EPA530-D-02-004. November.
- EPA. 2002b. "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites." OSWER 9285.6-10. December.
- EPA. 2002c. "Policy Considerations for the Application of Background Data in Risk Assessment and Remedy Selection, Role of Background in the CERCLA Cleanup Process." OSWER. OSWER 9285.6-07P. April 26.
- EPA. 2003. "Human Health Toxicity Values in Superfund Risk Assessments." OSWER Directive 9285.7-53. December.
- EPA. 2004a. "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings." OERR. February 22.
- EPA. 2004b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. OSWER. EPA/540/R/99/005. July.
- EPA. 2005. "Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens." Risk Assessment Forum. EPA/630/R-03/003F. March.
- EPA. 2009a. RAGS, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Office of Superfund Remediation and Technology Innovation. EPA-540-R-070-002. January.
- EPA. 2009b. Integrated Exposure Uptake Biokinetic Model for Lead in Children. Windows version (IEUBK win.version 1.1 Build 9). June. On-Line Address: http://www.epa.gov/superfund/lead/products.htm
- EPA. 2009c. ALM Spreadsheet (MS Excel). June 21. On-Line Address: http://www.epa.gov/superfund/lead/products/ALM_2009.xls
- EPA. 2009d. Technical Memorandum Regarding Update of the Adult Lead Methodology Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. From James E. Woolford, Director, Office of Superfund Remediation and Technology Innovation. To Superfund National Policy Managers and Regional Risk Leads. OSWER 9200.2-82. June 26. On-Line Address: http://www.epa.gov/superfund/lead/products/almupdate.pdf
- EPA. 2010a. "Vapor Intrusion Guidebook." Region 5, Superfund Division. October. On-Line Address: http://www.epaosc.org/sites/3806/files/VI%20Guidebook%20-%20%2010-1-10%20-%20final%20version.pdf

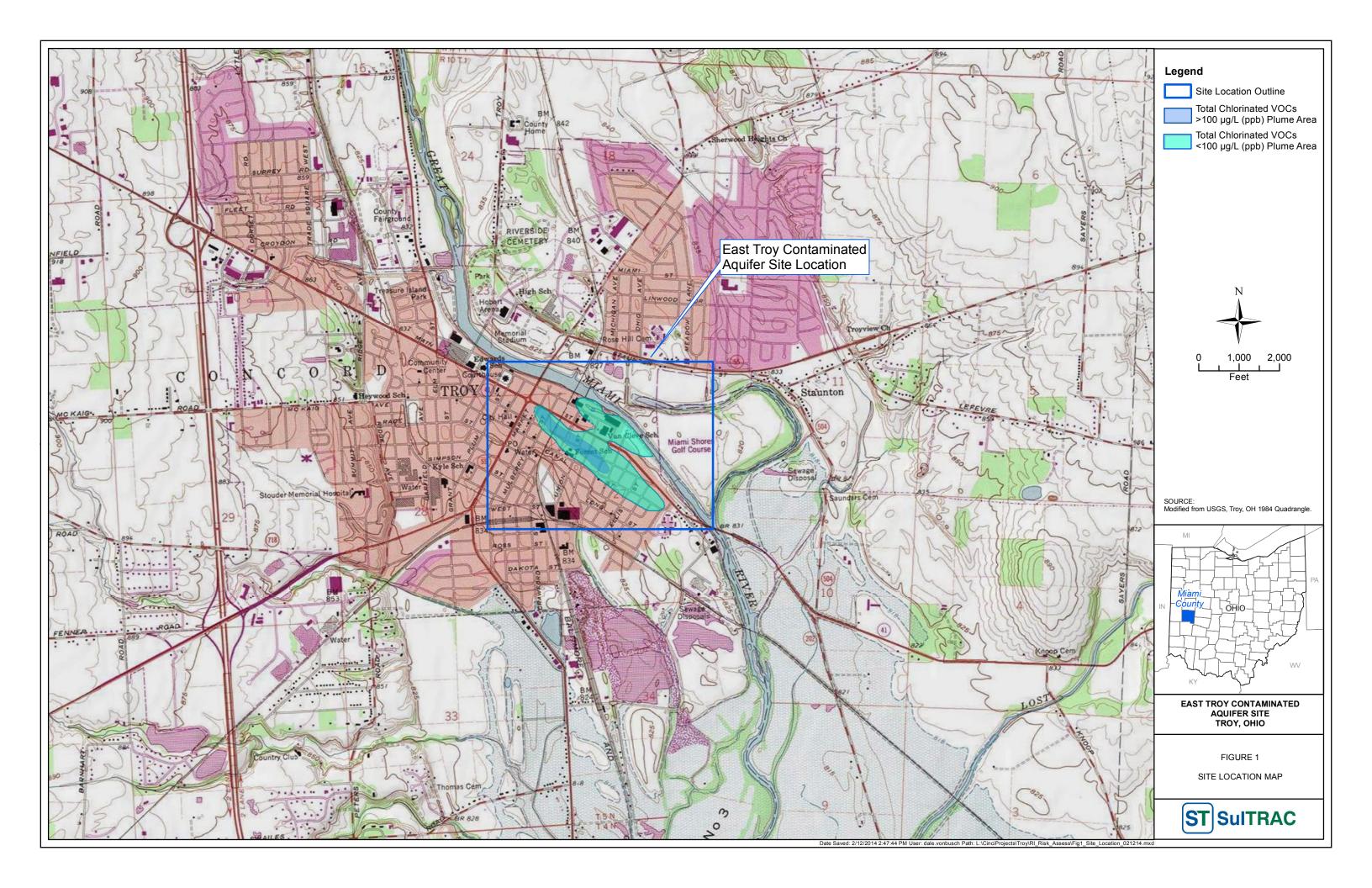
- EPA. 2011. "Exposure Factors Handbook: 2011 Edition." Office of Research and Development (ORD). EPA/600/R-090/052F. September. On-Line Address: http://www.epa.gov/ncea/efh/pdfs/efh-complete.pdf
- EPA. 2012. National Primary Drinking Water Regulations. June 5. On-Line Address: http://water.epa.gov/drink/contaminants/index.cfm#List
- EPA. 2013a. OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level (VISL) Calculator, Version 3.1, June 2013 RSLs. June. On-Line Address: http://www.epa.gov/oswer/vaporintrusion/guidance.html
- EPA. 2013b. Vapor Intrusion Screening Level (VISL) Calculator User's Guide. OSWER. June. On-Line Address: http://www.epa.gov/oswer/vaporintrusion/documents/VISL-UsersGuide.pdf
- EPA. 2013c. National Recommended Water Quality Criteria. August 22. On-Line Address: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
- EPA. 2013d. "ProUCL Version 5.0.00 User Guide, Statistical Software for Environmental Applications for Data Sets With and Without Nondetect Observations." ORD Site Characterization and Monitoring Technical Support Center (SCDMTSC). EPA/600/R-07/041. September. On-Line Address: http://www.epa.gov/osp/hstl/tsc/ProUCL_v5.0_user.pdf
- EPA. 2013e. "Regional Screening Level (RSL) Summary Table, November 2013." On-Line Address: http://www.epa.gov/region9/superfund/prg/
- EPA. 2013f. "User's Guide for Regional Screening Levels (November 2013)." On-Line Address: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm
- EPA. 2014. Integrated Risk Information System (IRIS). On-line Address: http://www.epa.gov/iris
- U.S. Fish and Wildlife Service (USFWS). 2013. Wetlands Mapper. On-Line address: http://www.fws.gov/wetlands/Data/Mapper.html. Accessed December 30, 2013. Last updated October 17, 2013.
- USFWS. 2014. Ohio, County Distribution of Federally-Listed Threatened. Endangered, Proposed, and Candidate Species. Revised January. On-Line address: http://www.fws.gov/midwest/endangered/lists/pdf/OhioCtyList2014.pdf
- U.S. Geological Survey (USGS). 2012. Average Concentrations of Elements in Miami County, Ohio. Mineral Resources On-Line Spatial Data. On-Line Address: http://tin.er.usgs.gov/geochem/county.php?place=f39109
- Virginia Department of Environmental Quality (VDEQ). 2013. Voluntary Remediation Program Risk Assessment Guidance. May. On-Line Address:

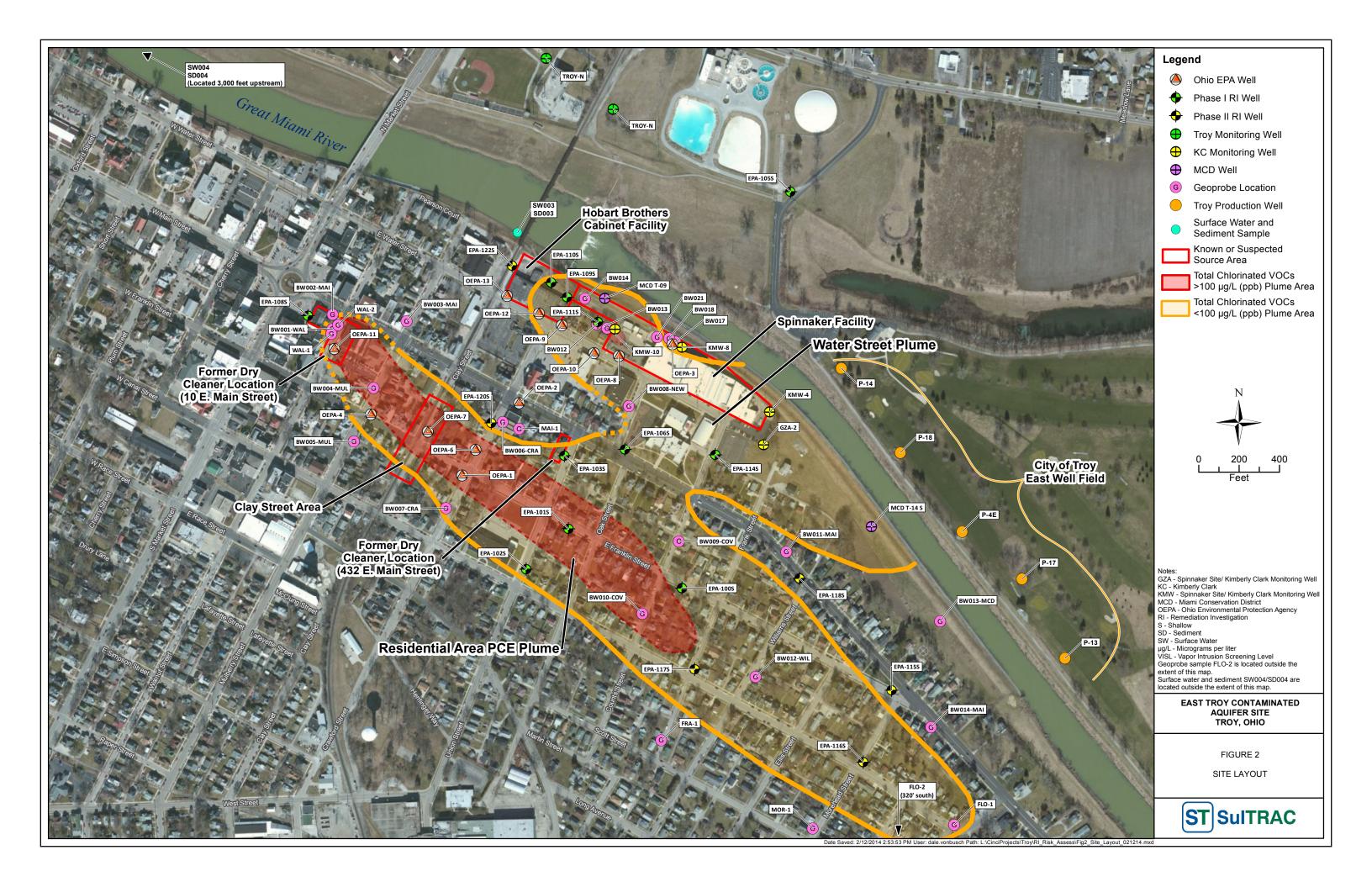
 http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance.aspx
- Whitaker, J.O. Jr., C.J. Amlaner, Jr., M.T. Jackson, G.R. Parker, and P.E. Scott. 2012. Habitats and Ecological Communities of Indiana: Presettlement to Present. Indiana University Press. 512 pp.

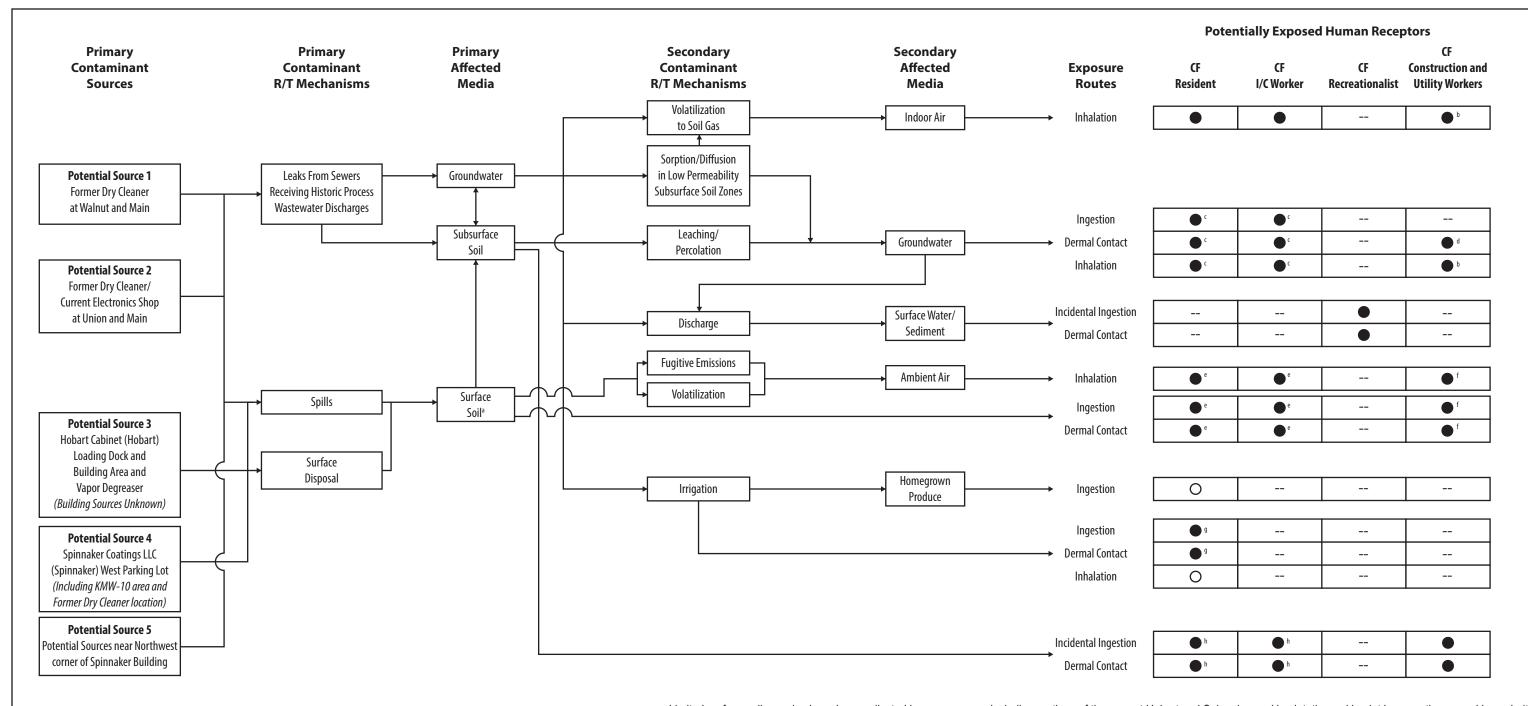












Notes:

R/T = Release/transport

O = Potentially complete, but insignificant exposure pathway - will not be retained for quantitative analysis

Potentially complete exposure pathway - retain for quantitative analysis

-- = Incomplete exposure pathway; will not be retained.

bgs = Below ground surface

C = Current

F = Future

I/C = Industrial - Commercial

- a = Limited surface soil samples have been collected in source areas, including portions of the current Hobart and Spinnaker parking lot; the parking lot is currently covered in asphalt.
- b = Exposure point concentrations for air in a construction or utility trench will be calculated using the methodology presented in Virginia Department of Environmental Quality's Voluntary Remediation Program Risk Assessment Guidance dated May 2013.
- c = There is no potable groundwater use in the neighborhood south of the river. Therefore, potable groundwater use south of the river will be evaluated only under a future land use scenario. North of the river, potential future use of the untreated groundwater from the City of Troy's East well field will also be evaluated.
- d = Exposure limited to groundwater present at or above 10 feet below ground surface.
- e = Soil samples were collected from various locations at the Hobart and Spinnaker properties as well as at residential properties southeast of Hobart along Water Street. Potential current and future exposure to soil at locations with grass, gravel, or dirt covering (at or near [residential properties]

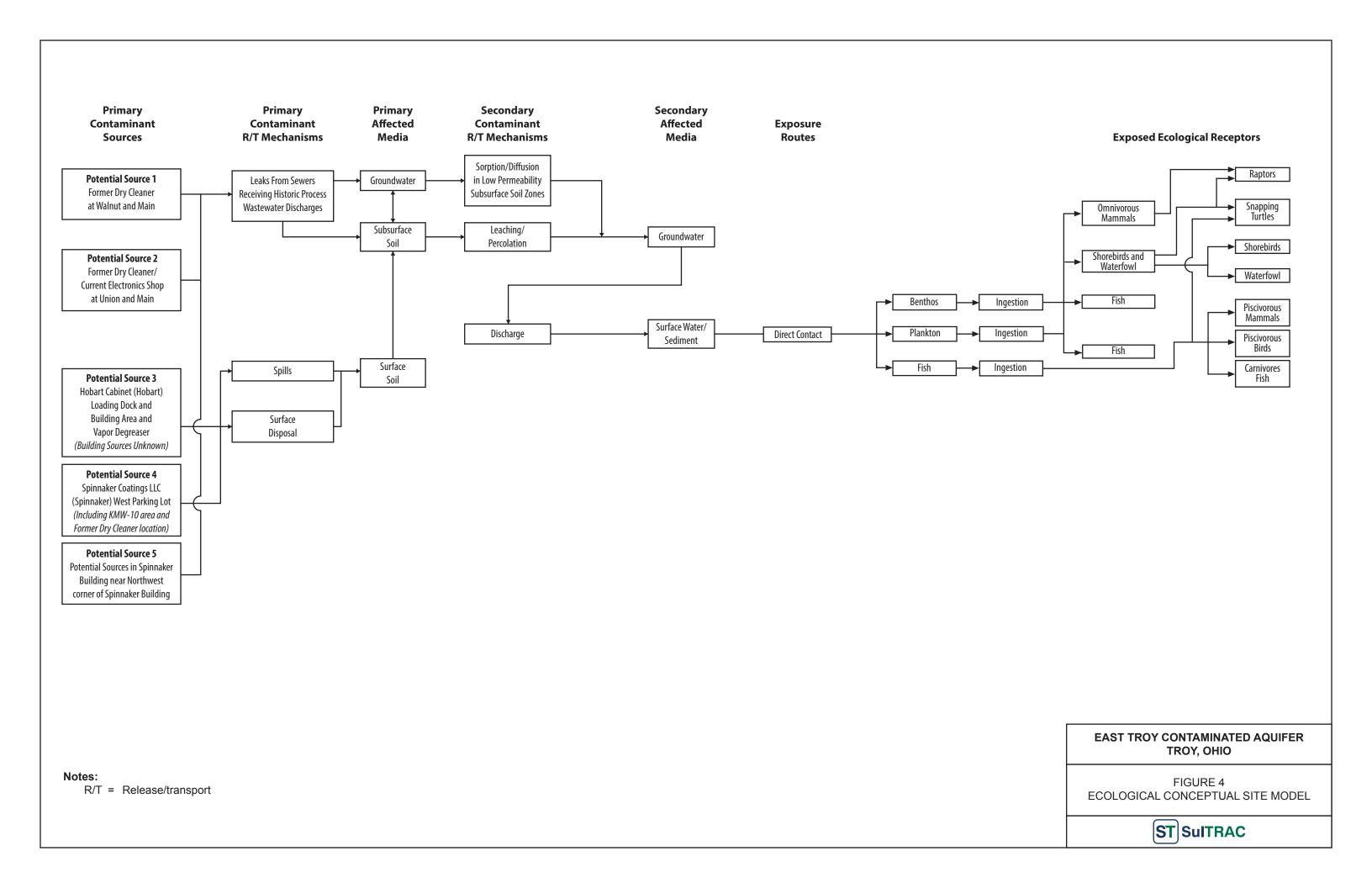
both Hobart and Spinnaker properties), as well as potential future exposure to soil beneath the current asphalt surface in the Spinnaker parking lot will be evaluated.

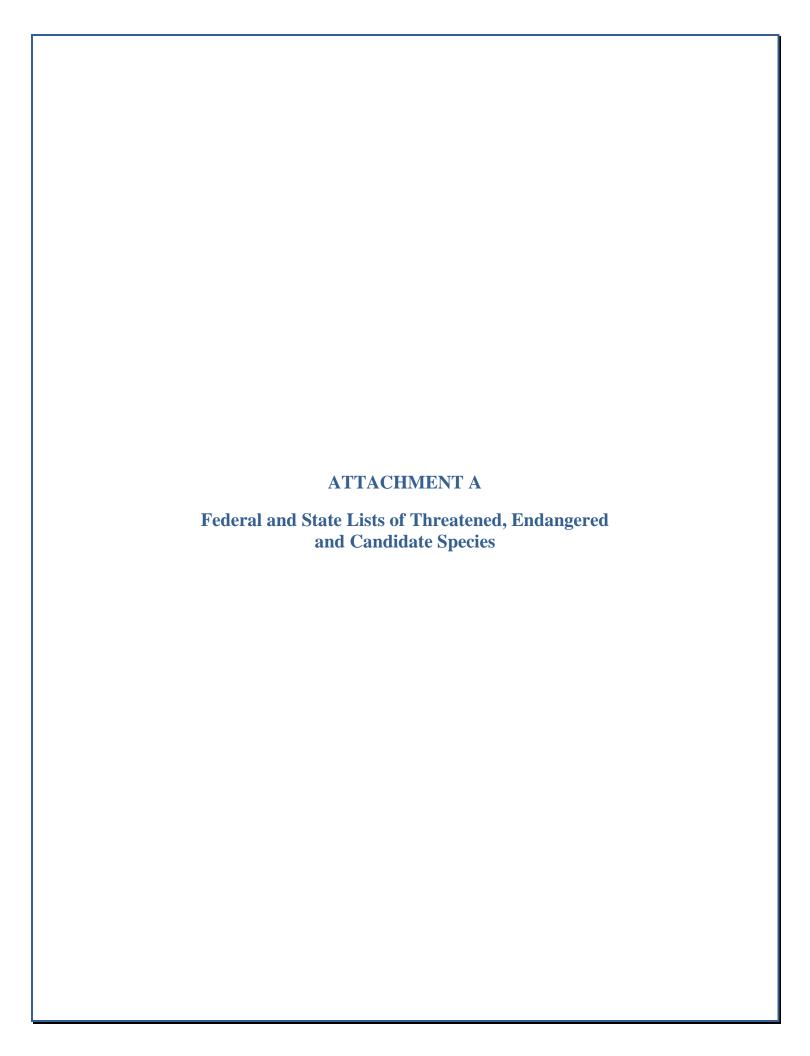
- f = Exposure to surface soil assumed to occur as part of exposure to subsurface soil (0 to 10 feet bgs).
- g = The potential for, types, and extent of current groundwater use (including irrigation) from private hand-driven wells will be evaluated using a neighborhood questionnaire. Potential future use of such wells will be assumed.
- h = Under future land use conditions, subsurface soil may be excavated, mixed with surface soil, and placed at the surface as the result of intrusive activities such as basement or foundation construction or grading. Therefore, potential exposure to subsurface soil is assumed to occur only under future land use conditions.

EAST TROY CONTAMINATED AQUIFER TROY, OHIO

FIGURE 3 HUMAN HEALTH CONCEPTUAL SITE MODEL







Ohio

County Distribution of Federally-Listed Threatened, Endangered, Proposed, and Candidate Species Revised January 2014

County	Species	Status	Habitat
Adams	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Allen	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Ashland	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Ashtabula	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.

	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April- May and late August-early October.
	Piping plover (Charadrius melodus)	Endangered	Beaches along shorelines of the Great Lakes
	Red Knot (Rufa) Calidris canutus rufa	Proposed Threatened	Present in Ohio during spring and fall migration
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Clubshell (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Athens	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	American burying beetle (Nicrophorus americanus)	Endangered	
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Auglaize	Indiana bat	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Belmont	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Brown	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests

	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Butler	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Carroll	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Champaign	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Clark	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.

	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	Mesic to wet prairies and meadows
Clermont	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Clinton	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Columbiana	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Coshocton	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests

	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland
			forests.
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	<u>Fanshell</u> (Cyprogenia stegaria	Endangered	Found in areas of packed sand and gravel at
	(=C. irrorata)		locations in a good current
	Purple cat's paw pearlymussel (Endangeredpioblasma obliquata obliquata)	Endangered	Gravel riffles of medium to large rivers
	Rabbitsfoot Quadrula cylindrica cylindrica	Threatened	
	Rabbitsfoot	Proposed	Walhonding River
	Quadrula cylindrica cylindrica	Critical Habitat	Map of Proposed Critical Habitat Unit
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	<u>Sheepnose</u> (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Crawford	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Cuyahoga	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April- May and late August-early October.
	Piping plover (Charadrius melodus)	Endangered	Beaches along shorelines of the Great Lakes
	Red Knot (Rufa) Calidris canutus rufa	Proposed Threatened	Present in Ohio during spring and fall migration
Darke	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests

	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Defiance	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Copperbelly water snake (Nerodia erythrogaster neglecta)	Threatened	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	White cat's paw pearlymussel (Epioblasma obliquata perobliqua)	Endangered	Firm sand or gravel riffles in small streams and medium to large rivers
Delaware	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Erie	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April-May and late August-early October.

	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Lakeside daisy (Hymenoxys herbacea) (Formerly H. acaulis) var. glabra)	Threatened	Dry rocky prairies; limestone rock surfaces including outcrops and quarries
	Piping plover (Charadrius melodus)	Endangered	Beaches along shorelines of the Great Lakes
	Piping plover (Charadrius melodus)	Critical Habitat Designated	
	Red Knot (Rufa) Calidris canutus rufa	Proposed Threatened	Present in Ohio during spring and fall migration
Fairfield	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Fayette	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Franklin	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Scioto madtom (Noturus trautmani)	Endangered	Stream riffles of moderate flow over sandy gravel bottom
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Rabbitsfoot Quadrula cylindrica cylindrica	Threatened	
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current

F. Jane	Indiana hat	Final circum.	Hibamaaaala Carra aad aataa
Fulton	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Gallia	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	<u>Sheepnose</u> (<i>Plethobasus cyphyus</i>)	Endangered	Shallow areas in larger rivers and streams
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Geauga	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Greene	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current

Guernsey	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Hamilton	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Hancock	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Hardin	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Copperbelly water snake (Nerodia erythrogaster neglecta)	Threatened	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods

	Eastern massasauga	Candidate	Wetlands and adjacent uplands
	(Sistrurus catenatus) Clubshell (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Harrison	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Henry	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Highland	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Hocking	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Northern monkshood (Aconitum noveboracense)	Threatened	Cool, moist, shaded cliff faces or talus slopes in wooded ravines, near water seeps
	American burying beetle (Nicrophorus americanus)	Endangered	
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
	Small whorled pogonia (Isotria medeoloides)	Threatened	Dry woodland; upland sites in mixed forests (second or third growth stage)
Holmes	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	Mesic to wet prairies and meadows

Homes	Indiana hat	Code : !	Hibamaaaala Carra arad satura
Huron	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Jackson	<u>Indiana bat</u> (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Jefferson	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Knox	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Lake	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April- May and late August-early October.
	Piping plover (Charadrius melodus)	Endangered	Beaches along shorelines of the Great Lakes
	<u>Piping plover</u> (Charadrius melodus)	Critical Habitat Designated	
	Red Knot (Rufa) Calidris canutus rufa	Proposed Threatened	Present in Ohio during spring and fall migration
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current

Lawrence	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Licking	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Logan	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Lorain	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April- May and late August-early October.

<u>Piping plover</u> Endangered Beaches along shorelines of the Great Lakes	
(Charadrius melodus)	
Red Knot (Rufa) Proposed Present in Ohio during spring and fall migration	n
Calidris canutus rufa Threatened	
Lucas Indiana bat Endangered Hibernacula = Caves and mines;	
(Myotis sodalis) Maternity and foraging habitat = small stream	
corridors with well developed riparian woods;	
upland forests	
Northern long-eared bat Proposed as Hibernates in caves and mines - swarming in	
Myotis septentrionalis Endangered surrounding wooded areas in autumn. During	
spring and summer roosts and forages in upla	ıd
forests.	
Kirtland's warbler (Dendroica Endangered Kirtland's warblers are known to migrate alon	3
kirtlandii) the Lake Erie shoreline counties (Ashtabula,	
Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April-	
May and late August-early October.	
Piping plover Endangered Beaches along shorelines of the Great Lakes	
(Charadrius melodus)	
Red Knot (Rufa) Proposed Present in Ohio during spring and fall migration	n
Calidris canutus rufa Threatened	
Eastern massasauga Candidate Wetlands and adjacent uplands	
(Sistrurus catenatus)	
Karner blue butterfly Endangered Pine barrens and oak savannas on sandy soils	and
(Lycaeides melissa samuelis) containing wild lupines (Lupinus perennis), the	
only known food plant of larvae.	
Rayed bean Endangered Smaller, headwater creeks, but they are	
(Villosa fabalis) sometimes found in large rivers	
Eastern prairie fringed orchid Threatened Mesic to wet prairies and meadows	
(Platanthera leucophaea)	
Madison Indiana bat Endangered Hibernacula = Caves and mines;	
(Myotis sodalis) Maternity and foraging habitat = small stream	
corridors with well developed riparian woods;	
upland forests	
Northern long-eared bat Proposed as Hibernates in caves and mines - swarming in	
Myotis septentrionalis Endangered surrounding wooded areas in autumn. During	
spring and summer roosts and forages in upla	ıd
forests.	
Scioto madtom Endangered Stream riffles of moderate flow over sandy gra	vel
(Noturus trautmani) bottom Clubshell Endangered Found in coarse sand and gravel areas of runs	224
<u>Clubshell</u> Endangered Found in coarse sand and gravel areas of runs (<i>Pleurobema clava</i>) riffles within streams and small rivers	anu
Northern riffleshell Endangered Large streams and small rivers in firm sand of	
(Epioblasma torulosa riffle areas; also occurs in Lake Erie	
rangiana)	
Rabbitsfoot Threatened	
Quadrula cylindrica cylindrica	
Rabbitsfoot Proposed Little Darby Creek	
Quadrula cylindrica cylindrica Critical Habitat Map of Proposed Critical Habitat Unit	
Rayed bean Endangered Smaller, headwater creeks, but they are	
(Villosa fabalis) sometimes found in large rivers	
Spuffhox Endangered Small to medium-sized creeks and some large	
Snuffbox Endangered Small to medium-sized creeks and some large (Epioblasma triquetra) rivers, in areas with a swift current	
Snuffbox (Epioblasma triquetra) Endangered Small to medium-sized creeks and some large rivers, in areas with a swift current	

Mahoning	Indiana bat	Endangered	Hibernacula = Caves and mines;
Widilolling	(Myotis sodalis)	Lindangered	Maternity and foraging habitat = small stream
			corridors with well developed riparian woods;
			upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late
			spring and summer roosts and forages in upland
	Factoria massassina	Candidate	forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Marion	Indiana bat	Endangered	Hibernacula = Caves and mines;
IVIGITOTI	(Myotis sodalis)	Liidaligered	Maternity and foraging habitat = small stream
	(, cas sea a,		corridors with well developed riparian woods;
			upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late
			spring and summer roosts and forages in upland
			forests.
	Eastern massasauga	Candidate	Wetlands and adjacent uplands
	(Sistrurus catenatus) Rayed bean	Endangorod	Smaller headwater creeks but they are
	(Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	(Vinosa jubuns)		Sometimes round in large rivers
Medina	Indiana bat	Endangered	Hibernacula = Caves and mines;
	(Myotis sodalis)		Maternity and foraging habitat = small stream corridors with well developed riparian woods;
			upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late
			spring and summer roosts and forages in upland
			forests.
Meigs	<u>Indiana bat</u>	Endangered	Hibernacula = Caves and mines;
	(Myotis sodalis)		Maternity and foraging habitat = small stream
			corridors with well developed riparian woods; upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late
	The second secon		spring and summer roosts and forages in upland
			forests.
	Fanshell (Cyprogenia stegaria	Endangered	Found in areas of packed sand and gravel at
	(=C. irrorata)		locations in a good current
	Pink mucket pearlymussel	Endangered	The lower Ohio River and its larger tributaries
	(Lampsilis abrupta)	Food-1	Challess again to see the second
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	(Fieurobusus cypriyus)		
	Snuffbox	Endangered	Small to medium-sized creeks and some larger
	(Epioblasma triquetra)		rivers, in areas with a swift current
Mercer	Indiana bat	Endangered	Hibernacula = Caves and mines;
	(Myotis sodalis)		Maternity and foraging habitat = small stream
			corridors with well developed riparian woods;
			upland forests

	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Miami	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Monroe	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Montgomery	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Morgan	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries

	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	<u>Snuffbox</u> (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
	American burying beetle (Nicrophorus americanus)	Endangered	
Morrow	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Muskingum	<u>Indiana bat</u> (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Rabbitsfoot Quadrula cylindrica cylindrica	Threatened	Muskingum River
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Noble	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Ottawa	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April- May and late August-early October.

	Piping plover	Endangered	Beaches along shorelines of the Great Lakes
	(Charadrius melodus)		2000.000 0.000 0.000 0.000 0.000
	Red Knot (Rufa) Calidris canutus rufa	Proposed Threatened	Present in Ohio during spring and fall migration
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	Mesic to wet prairies and meadows
	Lakeside daisy (Hymenoxys herbacea) (Formerly H. acaulis) var. glabra)	Threatened	Dry rocky prairies; limestone rock surfaces including outcrops and quarries
Paulding	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Perry	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	American burying beetle (Nicrophorus americanus)	Endangered	
Pickaway	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Scioto madtom (Noturus trautmani)	Endangered	Stream riffles of moderate flow over sandy gravel bottom
	Clubshell (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Rabbitsfoot (Quadrula cylindrica cylindrica)	Threatened	
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Pike	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests

	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late
			spring and summer roosts and forages in upland forests.
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Portage	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Mitchell's satyr butterfly (Neonympha mitchellii mitchellii)	Endangered	Fens; wetlands characterized by calcareous soils which are fed by carbonate-rich water from seeps and springs
	Northern monkshood (Aconitum noveboracense)	Threatened	Cool, moist, shaded cliff faces or talus slopes in wooded ravines, near water seeps
Preble	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
Putnam	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Richland	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands

Ross	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Sandusky	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Kirtland's warbler</u> (Dendroica kirtlandii)	Endangered	Kirtland's warblers are known to migrate along the Lake Erie shoreline counties (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky counties) through Ohio in late April- May and late August-early October.
	<u>Piping plover</u> (Charadrius melodus)	Endangered	Beaches along shorelines of the Great Lakes
	Red Knot (Rufa) Calidris canutus rufa	Proposed Threatened	Present in Ohio during spring and fall migration
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	Mesic to wet prairies and meadows
Scioto	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	<u>Fanshell</u> (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Pink mucket (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries

	Rayed bean	Endangered	Smaller, headwater creeks, but they are
	(Villosa fabalis)	Lindangered	sometimes found in large rivers
	Sheepnose	Endangered	Shallow areas in larger rivers and streams
	(Plethobasus cyphyus)		
	Snuffbox	Endangered	Small to medium-sized creeks and some larger
	(Epioblasma triquetra)	Lindangered	rivers, in areas with a swift current
	Running buffalo clover	Endangered	Disturbed bottomland meadows; disturbed sites
	(Trifolium stoloniferum)	Lindangered	that have shade during part of each day
	Small whorled pogonia	Threatened	Dry woodland; upland sites in mixed forests
	(Isotria medeoloides)		(second or third growth stage)
	<u>Virginia spiraea</u>	Threatened	Streambanks and floodplains
Compan	(Spirea virginiana)	Endangered	Hibernasula - Causs and minos
Seneca	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream
	(iniyotis soddiis)		corridors with well developed riparian woods;
			upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland
			forests.
Shelby	<u>Indiana bat</u>	Endangered	Hibernacula = Caves and mines;
	(Myotis sodalis)		Maternity and foraging habitat = small stream
			corridors with well developed riparian woods;
	Northern long-eared bat	Proposed as	upland forests
	Myotis septentrionalis	Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		spring and summer roosts and forages in upland
			forests.
	Rayed bean	Endangered	Smaller, headwater creeks, but they are
	(Villosa fabalis)		sometimes found in large rivers
Stark	Indiana bat	Endangered	Hibernacula = Caves and mines;
	(Myotis sodalis)		Maternity and foraging habitat = small stream corridors with well developed riparian woods;
			upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late
			spring and summer roosts and forages in upland forests.
Summit	Indiana bat	Endangered	Hibernacula = Caves and mines;
Jannine	(Myotis sodalis)	Lindangered	Maternity and foraging habitat = small stream
			corridors with well developed riparian woods;
		<u> </u>	upland forests
	Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
	Myotis septentrionalis	Endangered	surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland
		<u> </u>	forests.
	Northern monkshood	Threatened	Cool, moist, shaded cliff faces or talus slopes in
	(Aconitum noveboracense)		wooded ravines, near water seeps
Trumbull	Indiana bat	Endangered	Hibernacula = Caves and mines;
	(Myotis sodalis)		Maternity and foraging habitat = small stream corridors with well developed riparian woods;
			upland forests
	<u> </u>		apiana forcoto

Endangered Surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.		Northern long-eared bat	Proposed as	Hibernates in caves and mines - swarming in
Spring and summer roosts and forages in upland forests.			- I	=
Eastern masasauga Candidate Wetlands and adjacent uplands		Wiyous septementalis	Lindangered	=
Clubshell (Pleuroberna clava) Endangered Found in coarse sand and gravel areas of runs and riffles within streams and small rivers				
Clubshell (Pleuroberna clava) Endangered Found in coarse sand and gravel areas of runs and riffles within streams and small rivers		Eastern massasauga	Candidate	Wetlands and adjacent uplands
Tuscarawas				, ·
Indiana bat (Myotis sodalis)		<u>Clubshell</u>	Endangered	Found in coarse sand and gravel areas of runs and
Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Northern long-eared bat Myotis septentrionalis		(Pleurobema clava)		riffles within streams and small rivers
Northern long-eared bat Proposed as Endangered Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Myotis septentrionalis Proposed as Endangered Hibernates in caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Myotis septentrionalis Proposed as Endangered Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests	Tuscarawas	<u>Indiana bat</u>	Endangered	Hibernacula = Caves and mines;
Northern long-eared bat Proposed as Endangered Hilbernates in caves and mines - swarrning in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests. Indiana bat		(Myotis sodalis)		
Northern long-eared bat Myotis septentrionalis Proposed as Endangered Hilbernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.				• • •
Union Indiana bat (Myotis sodalis) Northern Ingread (Noturus trautmani) Clubshell (Pleurobema clava) Northern riffleshell (Epibolasma torulosa rangiana) Rabbitsfoot Quadrula cylindrica cylindrica Rayed bean (Villosa fabalis) Myotis septentrionalis Endangered Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests. Scioto madtom (Noturus trautmani) Clubshell (Findangered Endangered Found in coarse sand and gravel areas of runs and riffles within streams and small rivers Northern riffleshell (Epibolasma torulosa rangiana) Rabbitsfoot Quadrula cylindrica cylindrica Endangered Endangered Small to medium-sized creeks and some larger				·
Spring and summer roosts and forages in upland forests.			The state of the s	
Union Indiana bat (Myotis sodalis) Indiana bat (Mibernacula = Caves and mines; Indiana bat (Hibernacula = Caves and mines; Indiana bat (Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Indiana bat (Myotis sodalis) = small stream corridors in hibernation surrounding wooded areas in autumn. During late spring and surmer roosts and forages in upland forests. Indiana bat (Myotis sodalis) = small stream corridors in hibernation surrounding wooded areas in autumn. During late surrounding w		Myotis septentrionalis	Endangered	
Indiana bat (Myotis sodalis)				
Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests Northern long-eared bat Proposed as Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.				
Corridors with well developed riparian woods; upland forests Northern long-eared bat Proposed as Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests. Scioto madtom (Noturus trautmani) Endangered Stream riffles of moderate flow over sandy gravel bottom	Union		Endangered	• · · · · · · · · · · · · · · · · · · ·
Northern long-eared bat Myotis septentrionalis Endangered Scioto madtom (Noturus trautmani) Endangered Endangered Endangered Stream riffles of moderate flow over sandy gravel bottom		(Myotis soddiis)		
Northern long-eared bat Myotis septentrionalis Endangered Endangered Stream riffles of moderate flow over sandy gravel bottom				
Scioto madtom (Noturus trautmani) Endangered Stream riffles of moderate flow over sandy gravel bottom		Northern long-eared hat	Proposed as	·
spring and summer roosts and forages in upland forests. Scioto madtom (Noturus trautmani) Clubshell (Pleurobema clava) Northern riffleshell (Epioblasma torulosa rangiana) Rabbitsfoot Quadrula cylindrica cylindrica Rayed bean (Villosa fabalis) Snuffbox Endangered Stream riffles of moderate flow over sandy gravel bottom Found in coarse sand and gravel areas of runs and riffles within streams and small rivers Found in coarse sand and gravel areas of runs and riffles within streams and small rivers Found in coarse sand and gravel areas of runs and riffles within streams and small rivers Found in coarse sand and gravel areas of runs and riffles within streams and small rivers In the areas; also occurs in Lake Erie Little Darby Creek Map of Proposed Critical Habitat Unit Smaller, headwater creeks, but they are sometimes found in large rivers				
Scioto madtom (Noturus trautmani) Endangered Stream riffles of moderate flow over sandy gravel bottom		wiyous septementans	Lindangered	
Clubshell (Pleurobema clava) Endangered Found in coarse sand and gravel areas of runs and riffles within streams and small rivers				
Clubshell (Pleurobema clava) Endangered Found in coarse sand and gravel areas of runs and riffles within streams and small rivers		Scioto madtom	Endangered	Stream riffles of moderate flow over sandy gravel
Continue of the continue of		(Noturus trautmani)		
Northern riffleshell (Epioblasma torulosa rangiana) Endangered Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie		<u>Clubshell</u>	Endangered	Found in coarse sand and gravel areas of runs and
(Epioblasma torulosa rangiana) Rabbitsfoot Quadrula cylindrica cylindrica Rabbitsfoot Quadrula cylindrica cylindrica Critical Habitat Rayed bean (Villosa fabalis) Endangered Small to medium-sized creeks and some larger		(Pleurobema clava)		riffles within streams and small rivers
(Epioblasma torulosa rangiana) Rabbitsfoot Quadrula cylindrica cylindrica Rabbitsfoot Quadrula cylindrica cylindrica Critical Habitat Rayed bean (Villosa fabalis) Endangered Small to medium-sized creeks and some larger		Northorn rifflosholl	Endangorod	Large streams and small rivers in firm sand of
rangiana) Rabbitsfoot Threatened Quadrula cylindrica cylindrica Proposed Little Darby Creek Quadrula cylindrica cylindrica Critical Habitat Map of Proposed Critical Habitat Unit Rayed bean Endangered Smaller, headwater creeks, but they are sometimes found in large rivers Snuffbox Endangered Small to medium-sized creeks and some larger			Liluarigereu	
Rabbitsfoot Quadrula cylindrica cylindrica Proposed Little Darby Creek Quadrula cylindrica cylindrica Proposed Little Darby Creek Quadrula cylindrica cylindrica Map of Proposed Critical Habitat Unit Rayed bean (Villosa fabalis) Endangered Smaller, headwater creeks, but they are sometimes found in large rivers Snuffbox Endangered Small to medium-sized creeks and some larger		1 ' '		Time dieds, diso occurs in Edice Effe
Quadrula cylindrica cylindrica Rabbitsfoot Quadrula cylindrica cylindrica Proposed Critical Habitat Little Darby Creek Map of Proposed Critical Habitat Unit Rayed bean (Villosa fabalis) Endangered Smaller, headwater creeks, but they are sometimes found in large rivers Snuffbox Endangered Small to medium-sized creeks and some larger			Threatened	
Quadrula cylindrica cylindrica Critical Habitat Map of Proposed Critical Habitat Unit Rayed bean (Villosa fabalis) Endangered Smaller, headwater creeks, but they are sometimes found in large rivers Snuffbox Endangered Small to medium-sized creeks and some larger				
Rayed bean (Villosa fabalis) Endangered Smaller, headwater creeks, but they are sometimes found in large rivers		<u>Rabbitsfoot</u>	Proposed	Little Darby Creek
(Villosa fabalis) sometimes found in large rivers Snuffbox Endangered Small to medium-sized creeks and some larger		Quadrula cylindrica cylindrica	Critical Habitat	Map of Proposed Critical Habitat Unit
Snuffbox Endangered Small to medium-sized creeks and some larger		Rayed bean	Endangered	Smaller, headwater creeks, but they are
		(Villosa fabalis)		sometimes found in large rivers
		Spuffboy	Endangorod	Small to modium sized creeks and some larger
(Epiobiasina triquetra)			Endangered	
		(Epiobiasina triquetra)		invers, in areas with a switt current
Van Wert Indiana bat Endangered Hibernacula = Caves and mines;	Van Wert		Endangered	· ·
(Myotis sodalis) Maternity and foraging habitat = small stream		(Myotis sodalis)		
corridors with well developed riparian woods;				• • •
upland forests Northern long cared bat Proposed as Hibernates in cases and mines, swarming in		Northern long saved bat	Droposed as	
Northern long-eared bat Myotis septentrionalis Proposed as Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late			The state of the s	=
surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland		ινιγοτίς σεμτεπτιοπαπς	Endangered	<u> </u>
forests.				
Vinton Indiana bat Endangered Hibernacula = Caves and mines;	Vinton	Indiana bat	Endangered	
(Myotis sodalis) Chidangered Thibernactia – Caves and Thines, Maternity and foraging habitat = small stream	Tillon	<u> </u>	Lindungered	· ·
corridors with well developed riparian woods;		, , , , , , , , , , , , , , , , , , ,		
upland forests				

	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	American burying beetle (Nicrophorus americanus)	Endangered	
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Warren	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	Running buffalo clover (Trifolium stoloniferum)	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day
Washington	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Fanshell (Cyprogenia stegaria) (=C. irrorata)	Endangered	Found in areas of packed sand and gravel at locations in a good current
	Pink mucket pearlymussel (Lampsilis abrupta)	Endangered	The lower Ohio River and its larger tributaries
	Sheepnose (Plethobasus cyphyus)	Endangered	Shallow areas in larger rivers and streams
	Snuffbox (Epioblasma triquetra)	Endangered	Small to medium-sized creeks and some larger rivers, in areas with a swift current
Wayne	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands
	Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	Mesic to wet prairies and meadows

1			
Williams	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Copperbelly water snake (Nerodia erythrogaster neglecta)	Threatened	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods
	<u>Clubshell</u> (Pleurobema clava)	Endangered	Found in coarse sand and gravel areas of runs and riffles within streams and small rivers
	Northern riffleshell (Epioblasma torulosa rangiana)	Endangered	Large streams and small rivers in firm sand of riffle areas; also occurs in Lake Erie
	Rabbitsfoot Quadrula cylindrica cylindrica	Threatened	
	Rabbitsfoot Quadrula cylindrica cylindrica	Proposed Critical Habitat	Fish Creek Map of Proposed Critical Habitat Unit
	Rayed bean (Villosa fabalis)	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
	White cat's paw pearlymussel (Epioblasma obliquata perobliqua)	Endangered	Firm sand or gravel riffles in small streams and medium to large rivers
Wood	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Wyandot	Indiana bat (Myotis sodalis)	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well developed riparian woods; upland forests
	Northern long-eared bat Myotis septentrionalis	Proposed as Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
	Eastern massasauga (Sistrurus catenatus)	Candidate	Wetlands and adjacent uplands

Ohio Division of Wildlife Natural Heritage Database State-listed Species for Miami Co. As of 11/8/2012

Last Recorded	Scientific Name	Common Name	<u>State</u> Status	<u>Federal</u> <u>Status</u>
110001404				
PLANTS				
1986	Amelanchier sanguinea	Rock Serviceberry	Т	
1997	Arnoglossum plantagineum	Fen Indian-plantain	Р	
1977	Calamintha arkansana	Limestone Savory	Т	
2004	Campanula rotundifolia	Harebell	Т	
2007	Carex timida	Timid Sedge	Т	
1981	Deschampsia cespitosa	Tufted Hair Grass	Р	
1982	Helianthus mollis	Ashy Sunflower	T	
1990	Juncus balticus	Baltic Rush	Р	
2008	Melanthium woodii	Wood's-hellebore	Т	
1981	Minuartia michauxii	Rock Sandwort	Р	
1985	Phaseolus polystachios	Wild Kidney Bean	Р	
1979	Rhynchospora alba	White Beak-rush	Р	
1999	Salix myricoides	Blue-leaved Willow	Р	
1997	Triglochin maritimum	Seaside Arrow-grass	T	
1980	Triglochin palustris	Marsh Arrow-grass	Р	
1980	Utricularia intermedia	Flat-leaved Bladderwort	T	
2004	Zigadenus elegans	White Wand-lily	Р	
ANIMALS				
1987	Cistothorus platensis	Sedge Wren	SC	
1985	Etheostoma exile	Iowa Darter	Е	
2000	Etheostoma microperca	Least Darter	SC	
1983	Hybognathus nuchalis	Mississippi Silvery Minnow	X	
2001	Lasmigona compressa	Creek Heelsplitter	SC	
1968	Myotis sodalis	Indiana Bat	E	FE
1976	Taxidea taxus	Badger	SC	

Ohio Division of Wildlife Natural Heritage Database State-listed Species for Miami Co. As of 11/8/2012

Last Recorded	Scientific Name	Common Name	<u>State</u> Status	<u>Federal</u> <u>Status</u>
110001404				
PLANTS				
1986	Amelanchier sanguinea	Rock Serviceberry	Т	
1997	Arnoglossum plantagineum	Fen Indian-plantain	Р	
1977	Calamintha arkansana	Limestone Savory	Т	
2004	Campanula rotundifolia	Harebell	Т	
2007	Carex timida	Timid Sedge	Т	
1981	Deschampsia cespitosa	Tufted Hair Grass	Р	
1982	Helianthus mollis	Ashy Sunflower	T	
1990	Juncus balticus	Baltic Rush	Р	
2008	Melanthium woodii	Wood's-hellebore	Т	
1981	Minuartia michauxii	Rock Sandwort	Р	
1985	Phaseolus polystachios	Wild Kidney Bean	Р	
1979	Rhynchospora alba	White Beak-rush	Р	
1999	Salix myricoides	Blue-leaved Willow	Р	
1997	Triglochin maritimum	Seaside Arrow-grass	T	
1980	Triglochin palustris	Marsh Arrow-grass	Р	
1980	Utricularia intermedia	Flat-leaved Bladderwort	T	
2004	Zigadenus elegans	White Wand-lily	Р	
ANIMALS				
1987	Cistothorus platensis	Sedge Wren	SC	
1985	Etheostoma exile	Iowa Darter	Е	
2000	Etheostoma microperca	Least Darter	SC	
1983	Hybognathus nuchalis	Mississippi Silvery Minnow	X	
2001	Lasmigona compressa	Creek Heelsplitter	SC	
1968	Myotis sodalis	Indiana Bat	E	FE
1976	Taxidea taxus	Badger	SC	